

# **Overview of Proposed Transportation Energy Analyses**

**California Energy Commission  
Staff Presentation  
Hearing Room A**

February 10, 2009

Fossil Fuels Office  
Fuels and Transportation Division

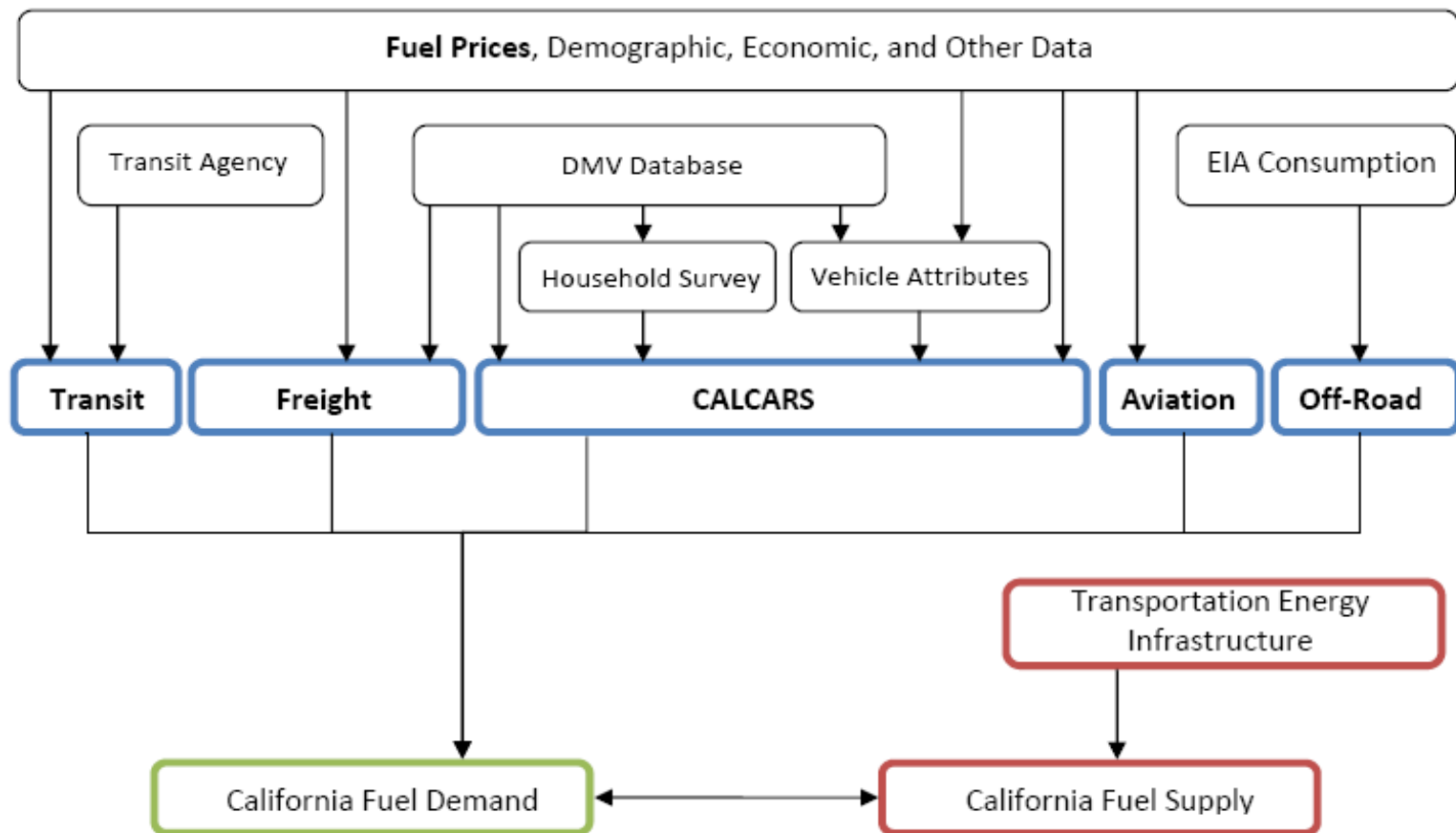


# Objectives

- Overall framework and approach
- Demand model discussion – methods, inputs, and assumptions
- Crude oil and petroleum fuel price forecasts
- Alternative and renewable fuels price forecasts
- Next steps



# Data Flow to Transportation Energy Demand Models



# California Energy Commission Transportation Energy Demand Models

The models proposed to forecast transportation energy demand for the 2009 IEPR include:

1. CALCARS (light and medium-duty vehicles)
2. Freight
3. Transit (urban and intercity)
4. Aviation (commercial)



# Proposed Forecasted Transportation Fuels for the 2009 IEPR

Staff intends to include the following fuels in the transportation energy demand forecasts:

1. Gasoline
2. Diesel
3. Electricity
4. E85 (85 percent Ethanol blended with gasoline)
5. Natural gas
6. Jet fuel
7. Biomass-based Diesel
8. Propane
9. Hydrogen



# Economic and Demographic Data Used in Modeling

The Economic and Demographic Data includes:

- Population
- Employment growth rates
- Personal Income
- Industrial activity for 23 NAICS
- On-road registered vehicles
- Fuel Prices
- Transportation costs (ticket prices and fares)



# Proposed Demand Forecast Cases

<b>Policy Scenario</b>	<b>Low Petroleum Fuel Prices</b>	<b>High Petroleum Fuel Prices</b>
<b>GHG Regulations and EISA</b>	Case 1	Case 2
<b>Pavley 2 Regulations</b>	Case 3	Case 4
<b>Lower or Incentivized Alternative Fuel Prices</b>	Case 5	Case 6
<b>Incentivized Alternative Fuel Vehicle Prices</b>	Case 7	Case 8



# Crude Oil and Transportation Fuel Price Forecasts





# Forecasting Challenges

- Unprecedented volatility in crude oil and fuel markets
- Lack of in-house world energy model
- In-house models and available data support annual average statewide forecasts
- Need to integrate alternative fuel forecasts into existing in-house models
- Forecast horizon to 2030

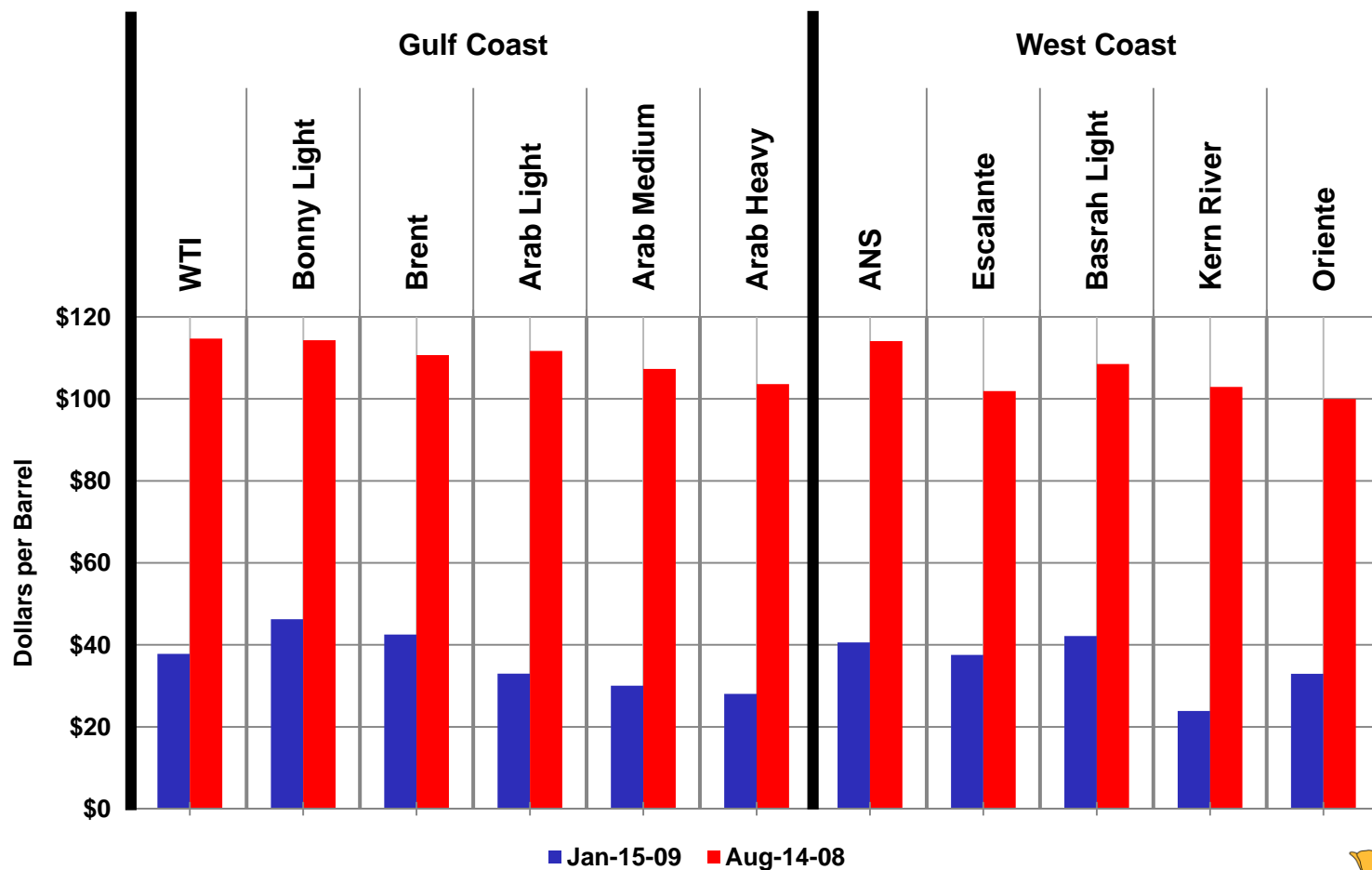


# Solutions

- Assess the use of crude oil price forecasts from EIA, IEA, or other organizations
- Use historical data on U.S. Imported Refiner Acquisition Cost (RAC) of crude oil and state petroleum fuel price relationships
- Consult with other offices on E-85, natural gas, hydrogen prices, and electric rates for EVs and plug-in-hybrids
- Solicit expert advice from workshop participants



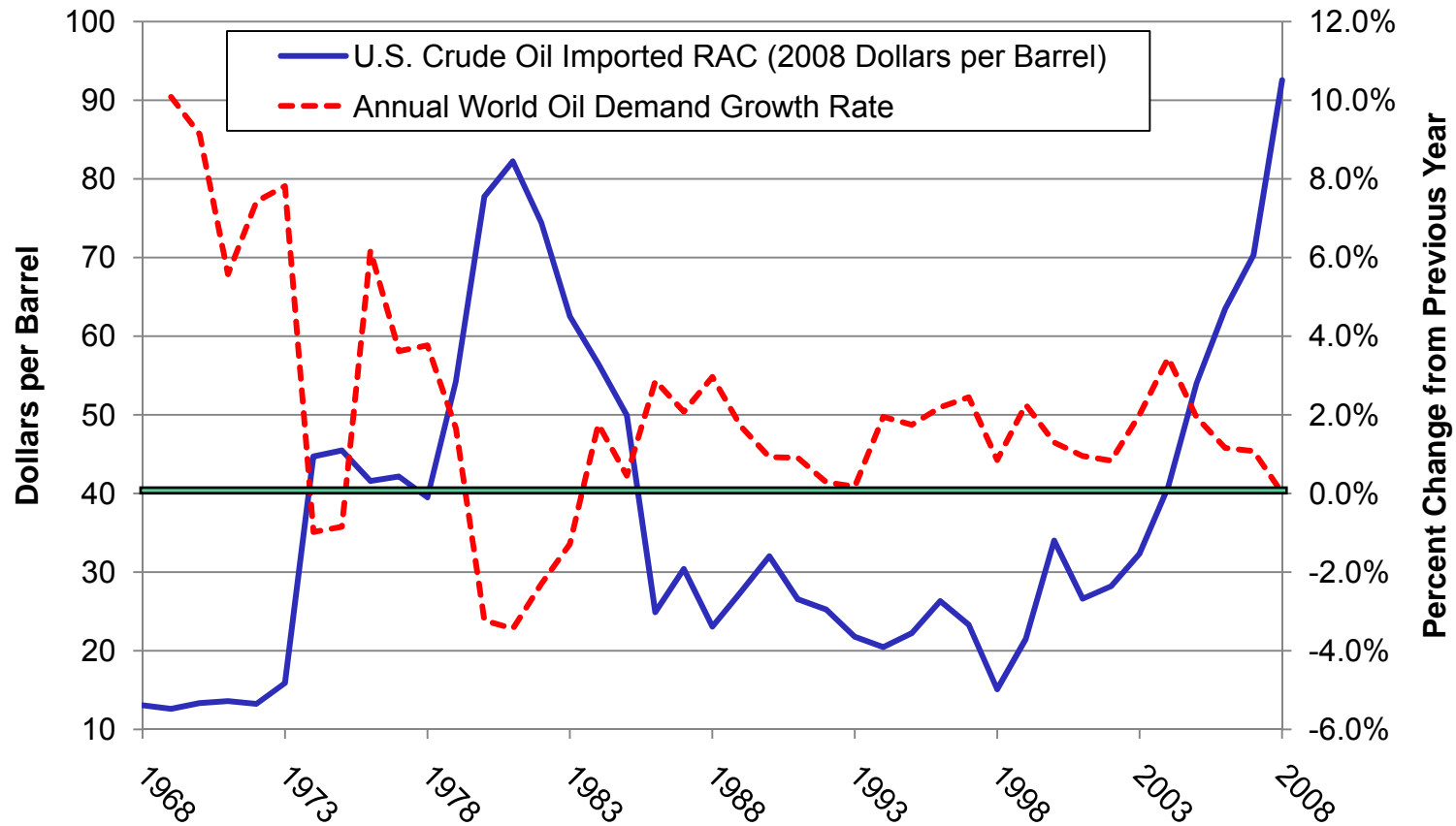
# Crude Oil Spot Price Indexes



Source: Platt's Oilgram & Price Report



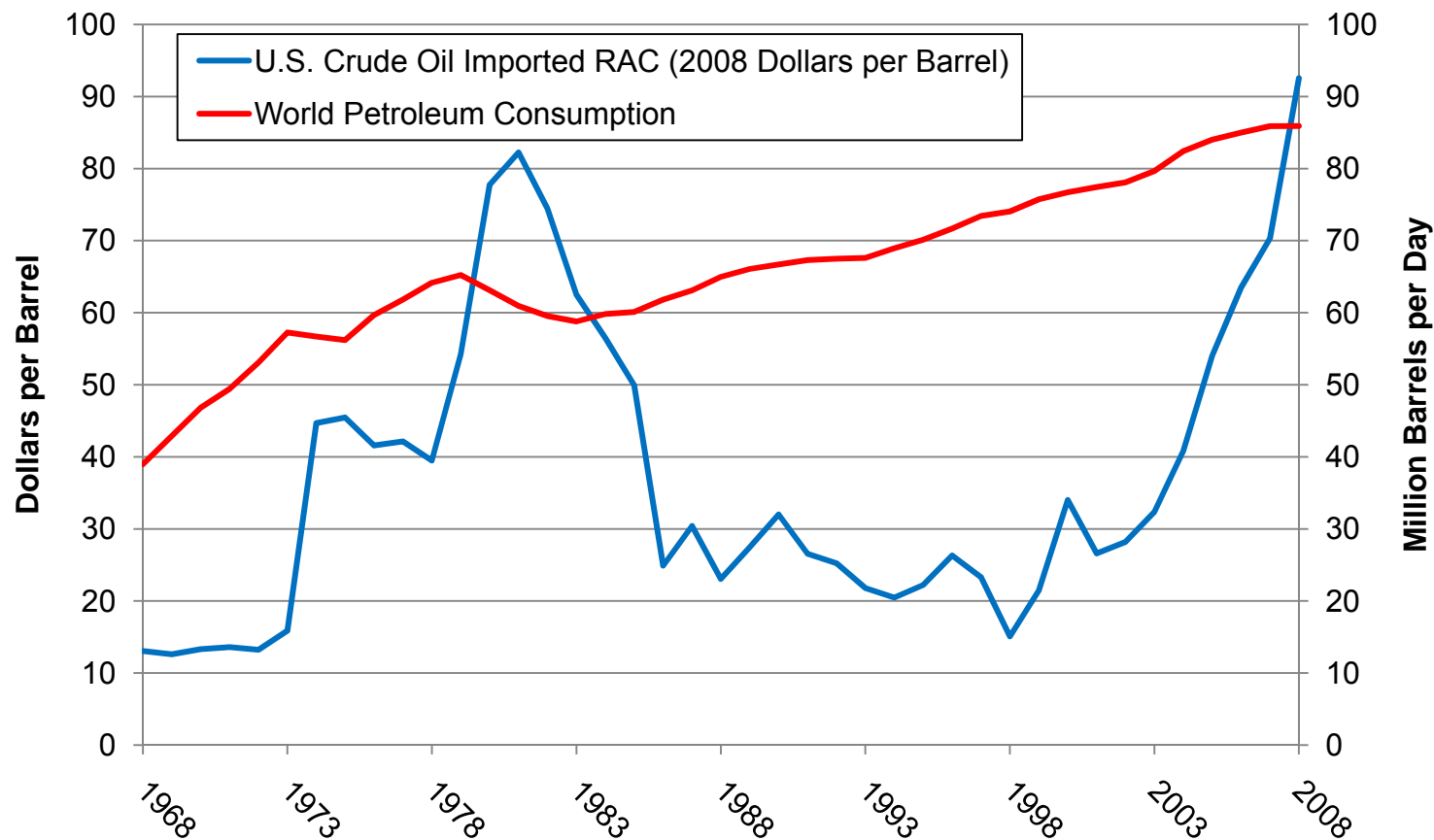
# U.S. RAC & World Oil Demand Growth



Source: U.S. Energy Information Administration



# U.S. RAC & Total World Oil Demand



Source: U.S. Energy Information Administration



# Causes of Oil and Fuel Price Increases (2003 to mid 2008)

- Increasing world petroleum demand
- Resource nationalism
- Rising oil production project costs
- Declining excess oil production capacity
- U.S. refinery outages
- Weather
- Dollar devaluation
- Increased speculative activity

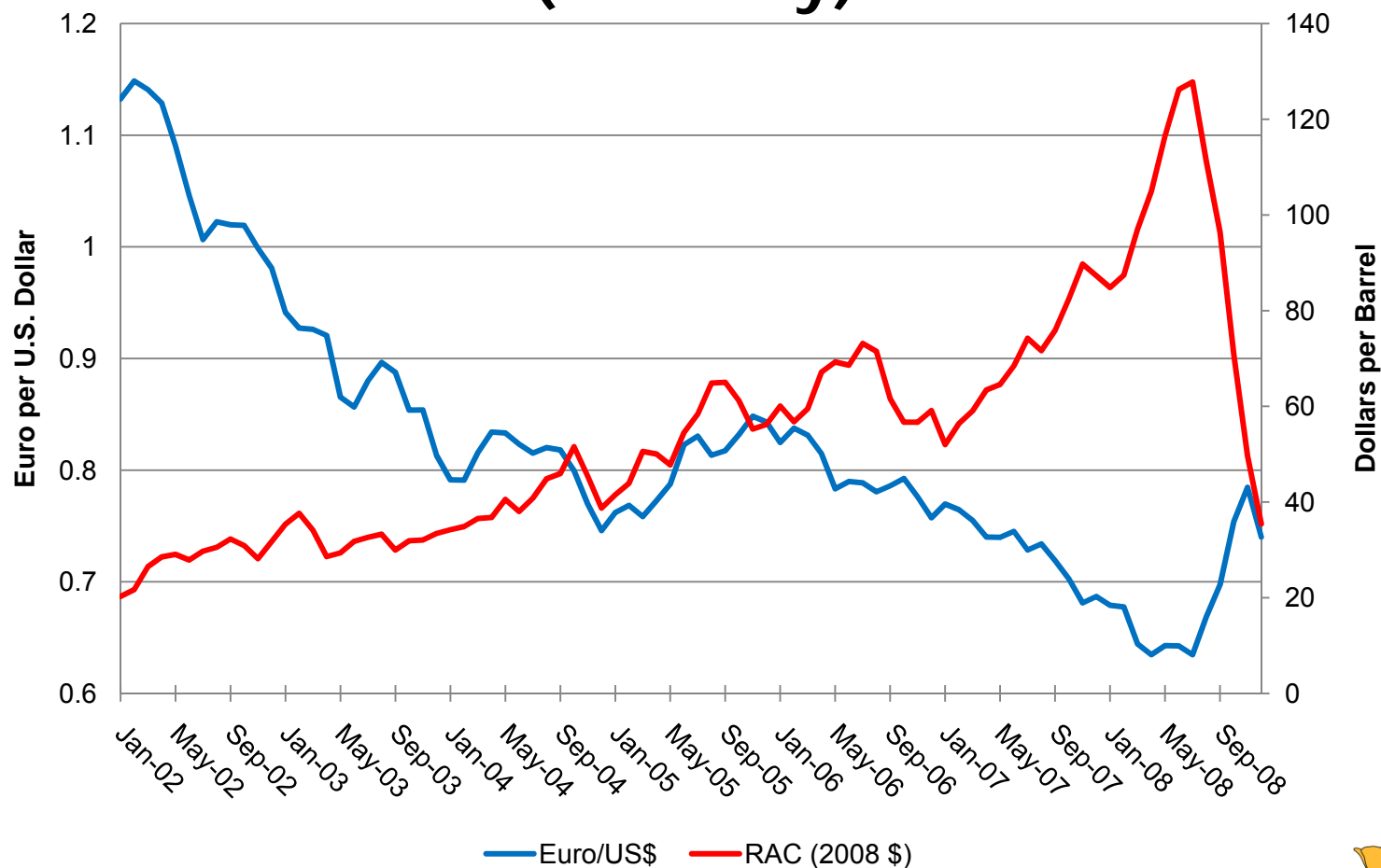


# Causes of Oil and Fuel Price Declines (late 2008 into 2009)

- World economic contraction
- Declining world oil demand growth rate
- Increasing excess oil production capacity
- Increasing U.S. oil inventories
- Increasing value of the Dollar



# U.S. Currency Value & Price of Crude Oil (Monthly)

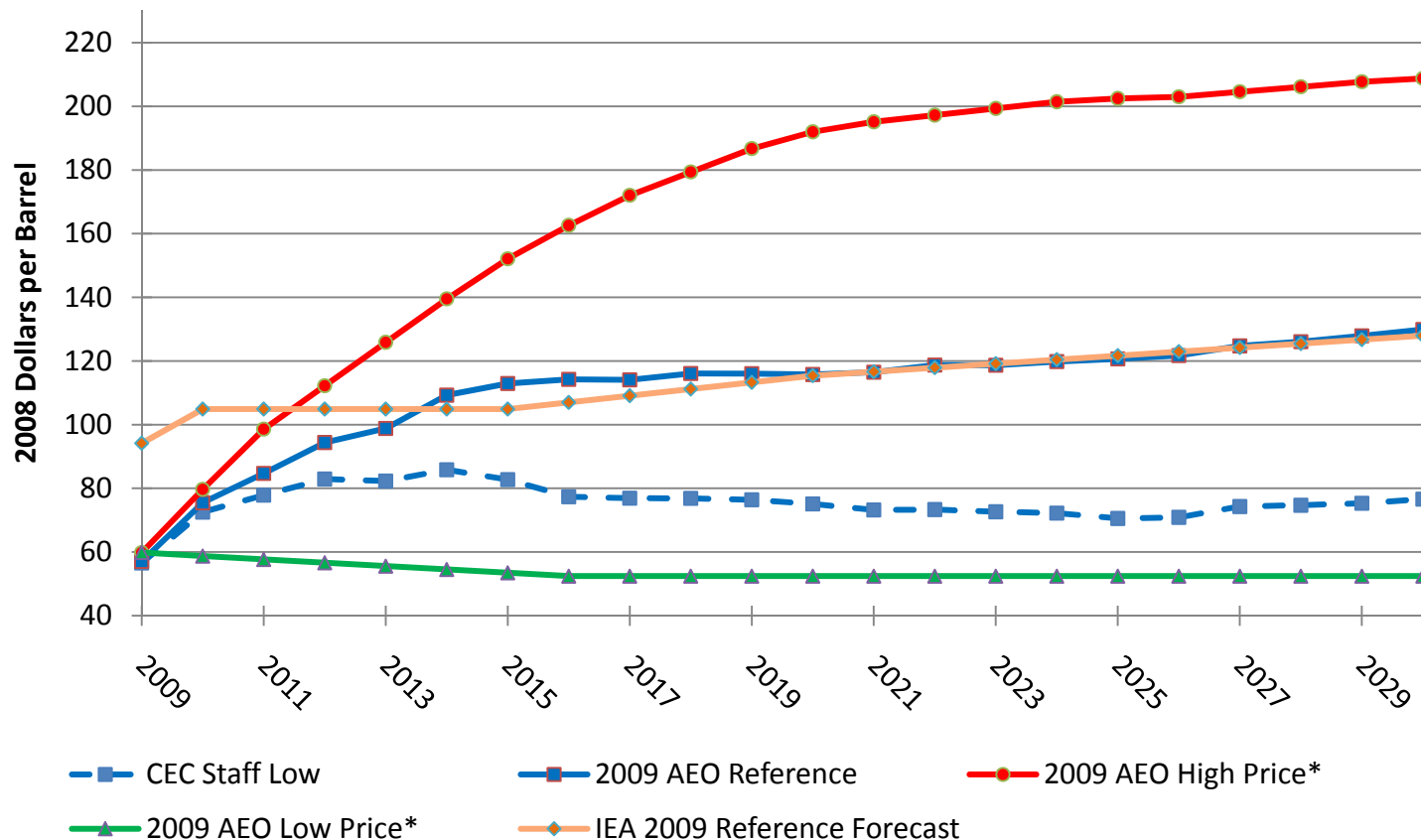


Source: U.S. Energy Information Administration





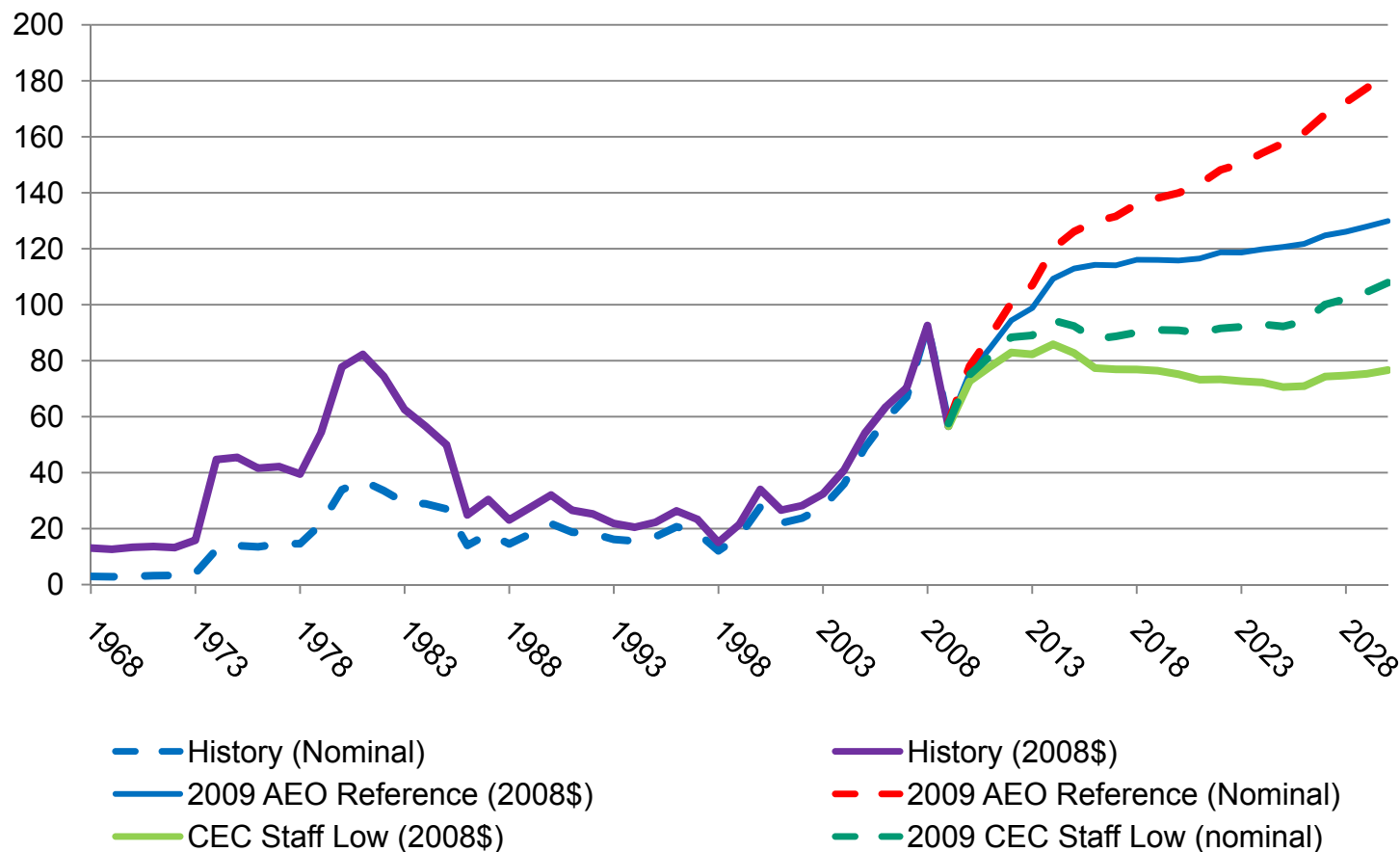
# EIA & IEA Crude Oil Price Forecasts (2008 Dollars)



Note: Indexed to U.S. Refiner Acquisition Cost of Imported Crude Oil  
(\*) denotes that price forecasts are Energy Commission estimates of EIA graphical information



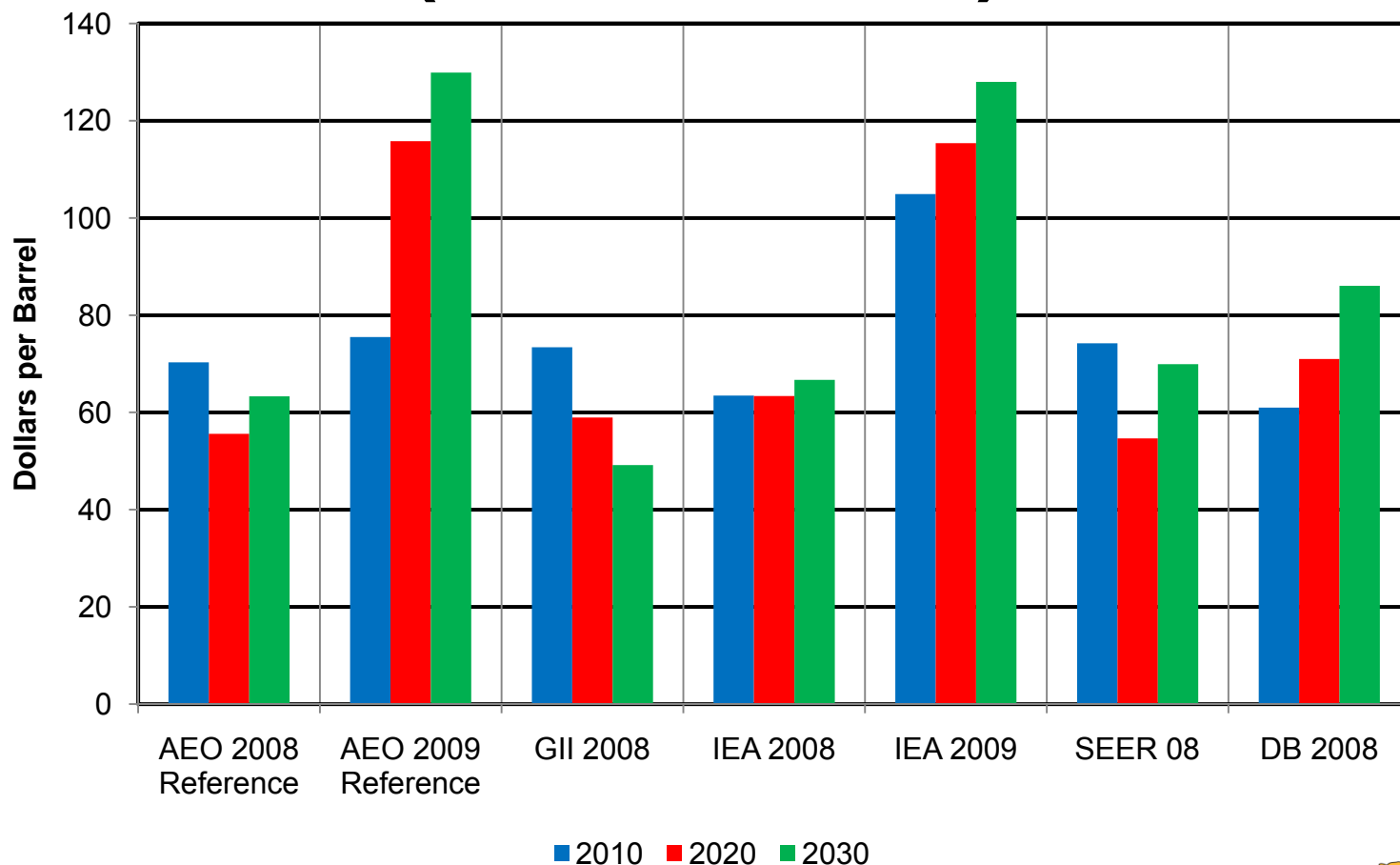
# U.S. RAC Historic & Forecast



Source: Energy Commission and U.S. Energy Information Administration



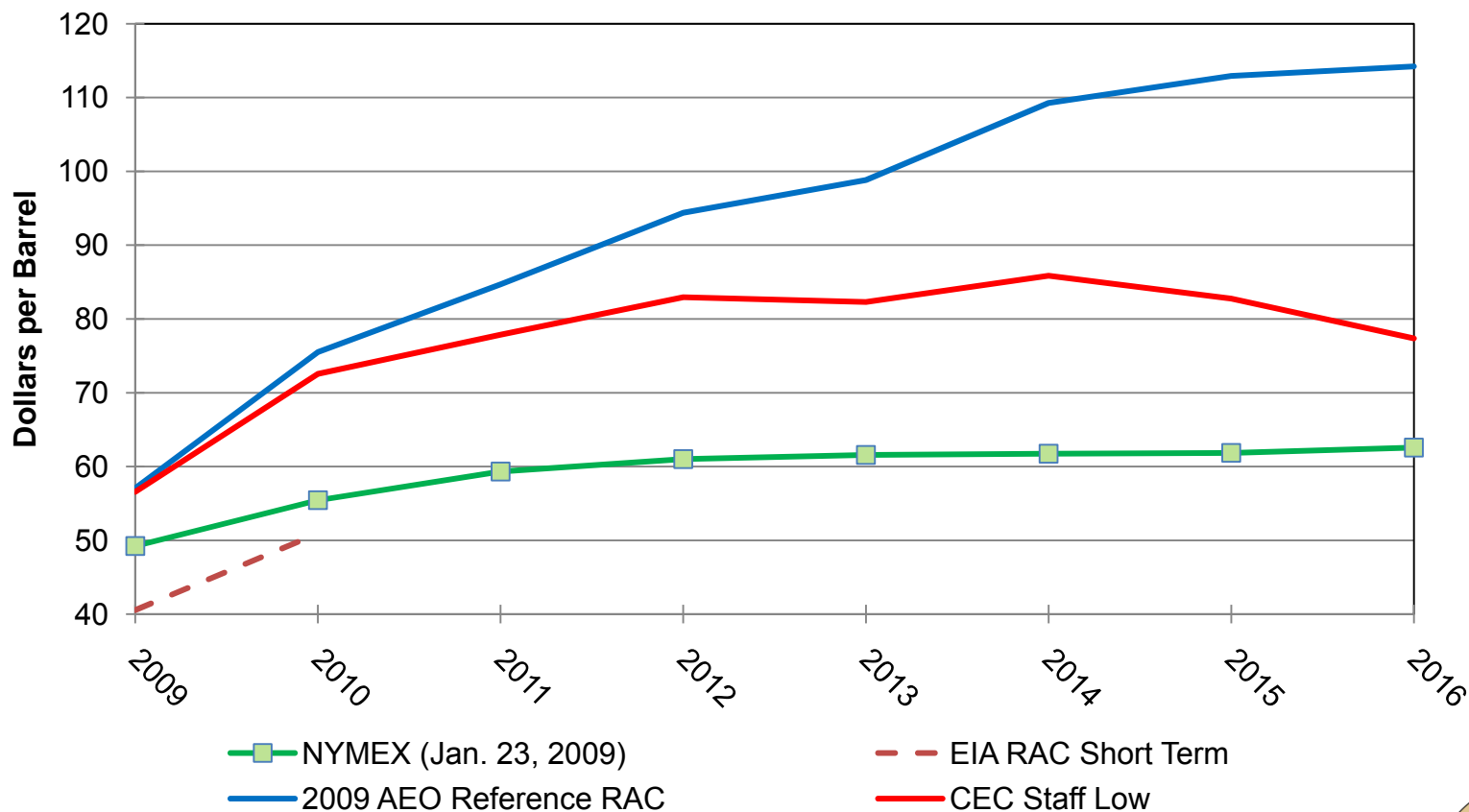
# Oil Price Forecasts by Forecast Year (2008 Dollars)



Source: U.S. Energy Information Administration



# Short- & Long-Term Price Forecasts Vs NYMEX Futures (2008 Dollars)



Source: Energy Commission, U.S. Energy Information Administration, and NYMEX



# Petroleum Transportation Fuel Price Forecasting Method

- Uses forecasted RAC oil price in cents per gallon
- Establishes and adds margins for fuel prices
  - RAC to rack price margin (High and Low)
  - Rack to retail price margin (High and Low)
- Adds California and federal taxes and fees (excise and sales)
- Includes the costs of E-10 changes, 10 cents (high) and 5 cents (low), starting in 2010 at half cost and in full effect by 2012

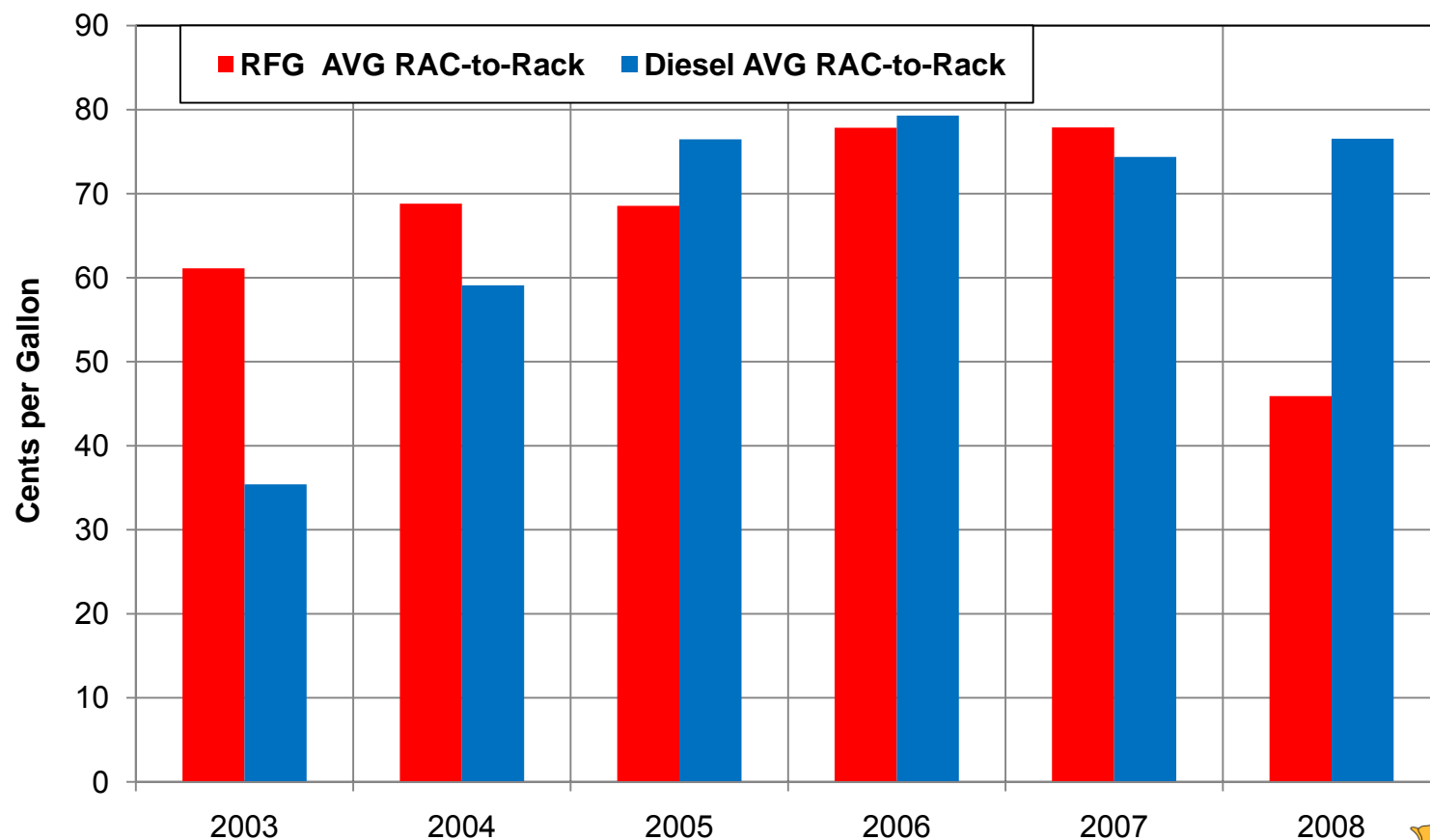


# Assumptions

- In real terms, fuel margins held constant
- California and federal excise taxes and fees are held constant in real terms
- Current or planned fuel formulations to remain constant
- No greenhouse gas reduction regulations beyond Pavley rules incorporated in forecasts



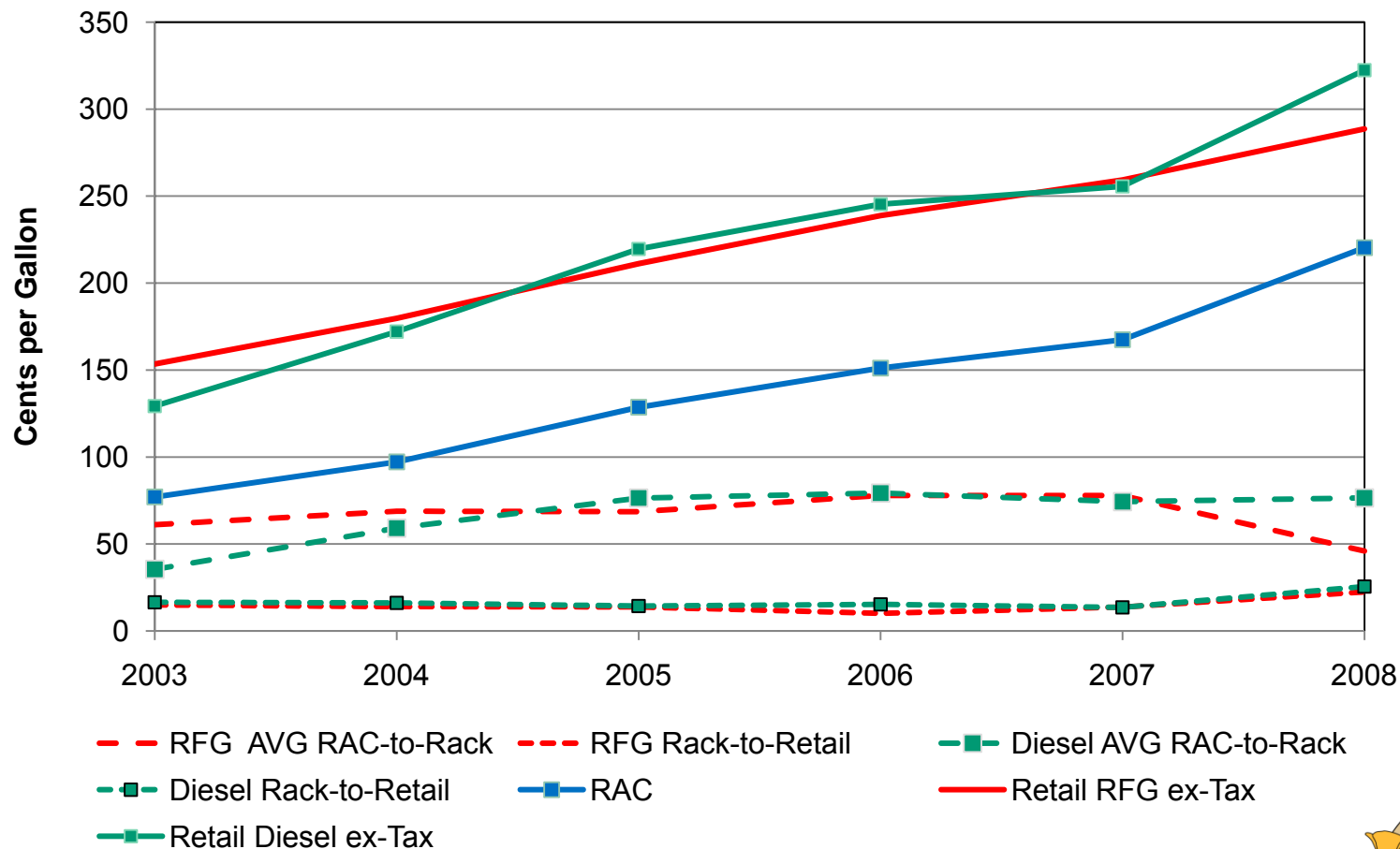
# California Gasoline and Diesel RAC-to-Rack Price Margins (2008 Cents)



Sources: Derived by Energy Commission staff from U.S. Energy Information Administration and OPIS data



# California Gasoline and Diesel Margins (2008 Cents)



Sources: Derived by Energy Commission staff from U.S. Energy Information Administration and OPIS data





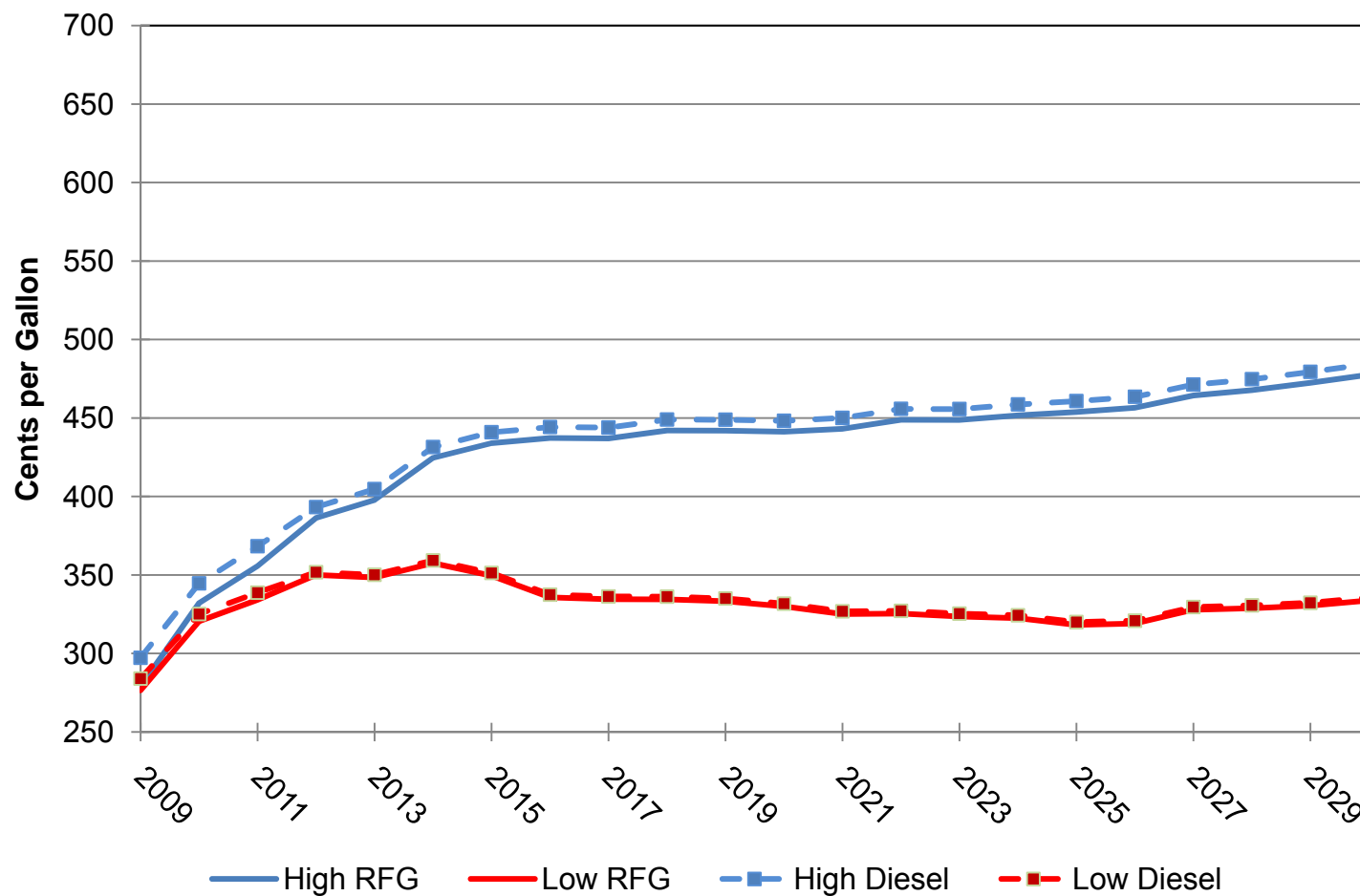
# California Transportation Fuel Price Margins & Adders (2008 Cents)

	RFG Crude-to- Rack	Diesel Crude-to- Rack	RFG Rack-to- Retail	Diesel Rack-to- Retail	RFG E-10 Adder (2012- 2030)	RFG E-10 Adder (2010- 2011)
CEC High (2006-2008 average)	67.2	76.7	15.5	18.1	10.0	5.0
CEC Low (2003-2008 average)	66.7	66.9	14.9	16.9	5.0	2.5

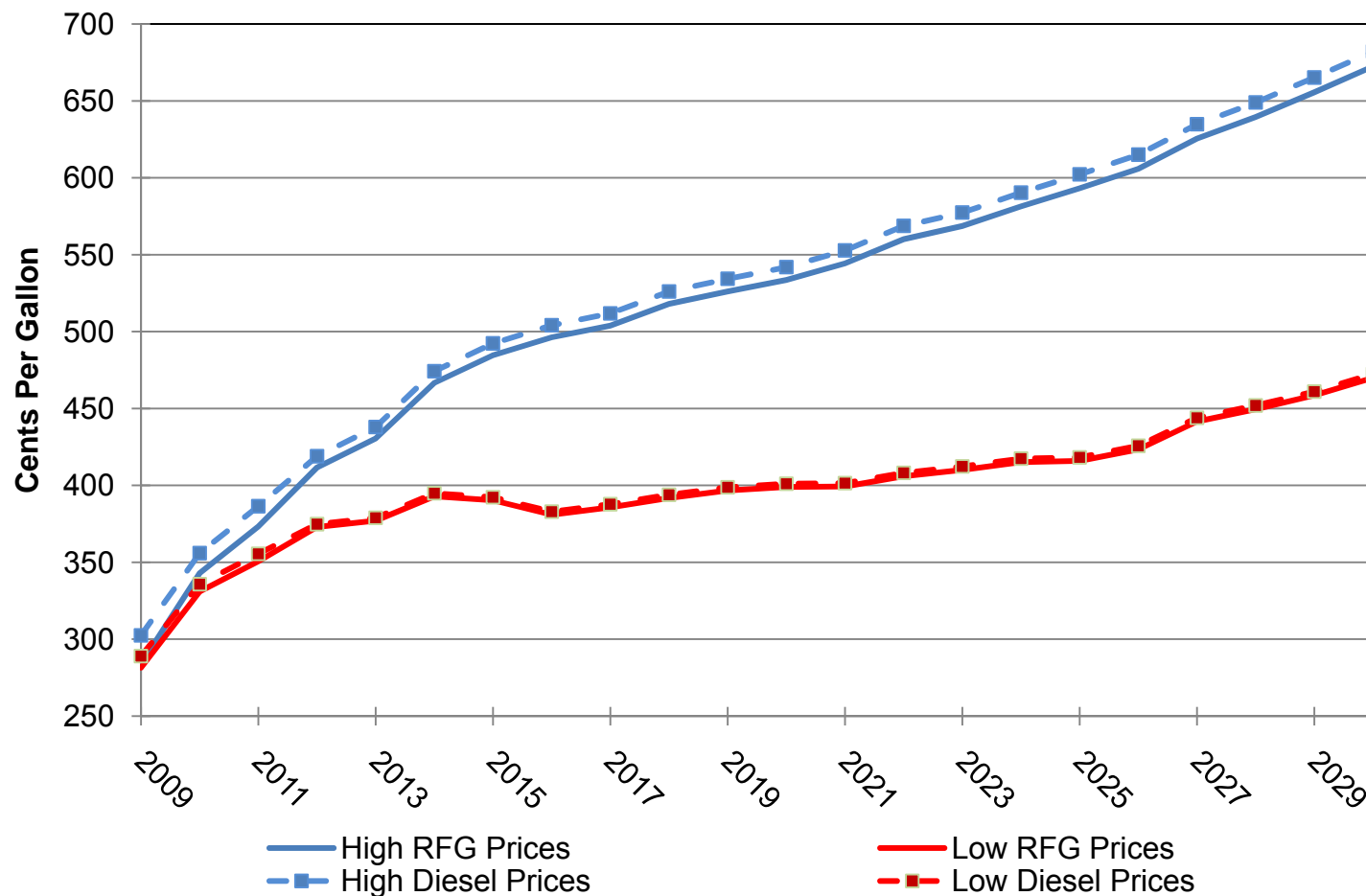
Sources: Derived by Energy Commission staff from U.S. Energy Information Administration and OPIS data



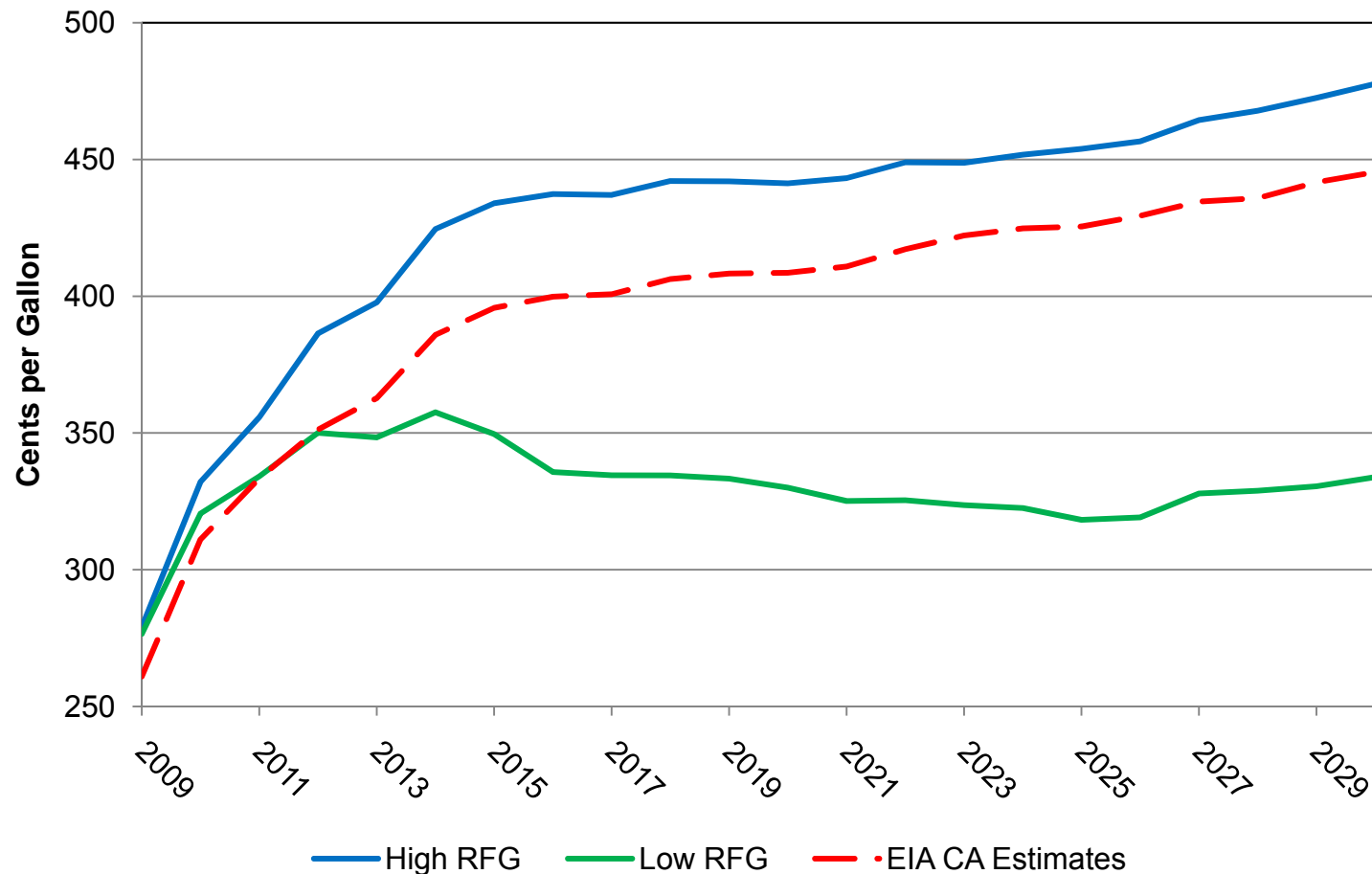
# California Regular-Grade Gasoline & Diesel Price Forecasts (2008 Cents)



# California Regular-Grade Gasoline & Diesel Price Forecasts (Nominal)



# EIA & Energy Commission Staff California Gasoline Price Forecasts (2008 Cents)



Sources: Energy Commission and U.S. Energy Information Administration



# Railroad Diesel and Jet Fuel Price Forecasts

## Railroad Diesel

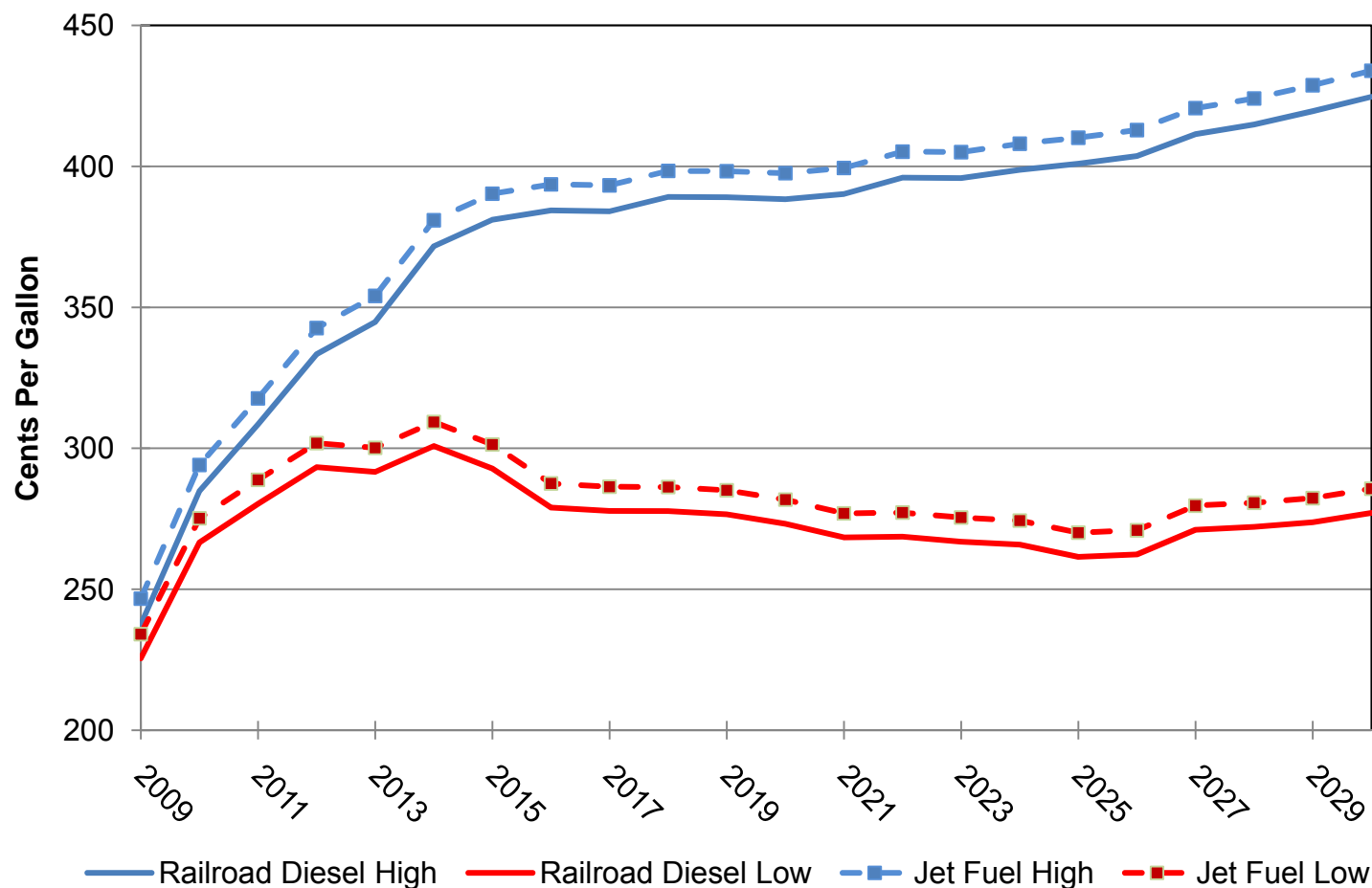
- CEC Diesel Rack price forecast
- 6.9 cent per gallon excise tax (state & federal)
- 8% California sales tax

## Jet Fuel

- CEC Diesel Rack price forecast
- 6.4 cent per gallon excise tax (state & federal)
- Distribution adder (1/2 of diesel rack-to-retail margin)
- 8% California sales tax



# California Railroad Diesel & Jet Fuel Price Forecasts (2008 Cents)



# Ethanol-85 Price Forecasting Method

- Ethanol-85 (E-85) fuel prices are calculated as ranges based on CEC RFG high and low price forecasts
- Upper boundary for the E-85 price is equal to the high CEC RFG price
- Lower boundary for the E-85 price is equal to the low CEC RFG price on an energy equivalent basis
- Yet to be determined whether to use the full range of E-85 price forecasts or a measure of its central tendency



# Volumetric Equivalence, Energy Equivalence, and GGEs

## Volumetric Equivalent Pricing

- Price of one gallon of gasoline = Price of one gallon of E85
  - \$2.00 per gallon of gasoline = \$2.00 per gallon of E85

## Energy Equivalent Pricing

- Price per Btu of gasoline = Price per Btu of E85
  - \$2.00 per gallon of gasoline = \$1.46 per gallon of E85

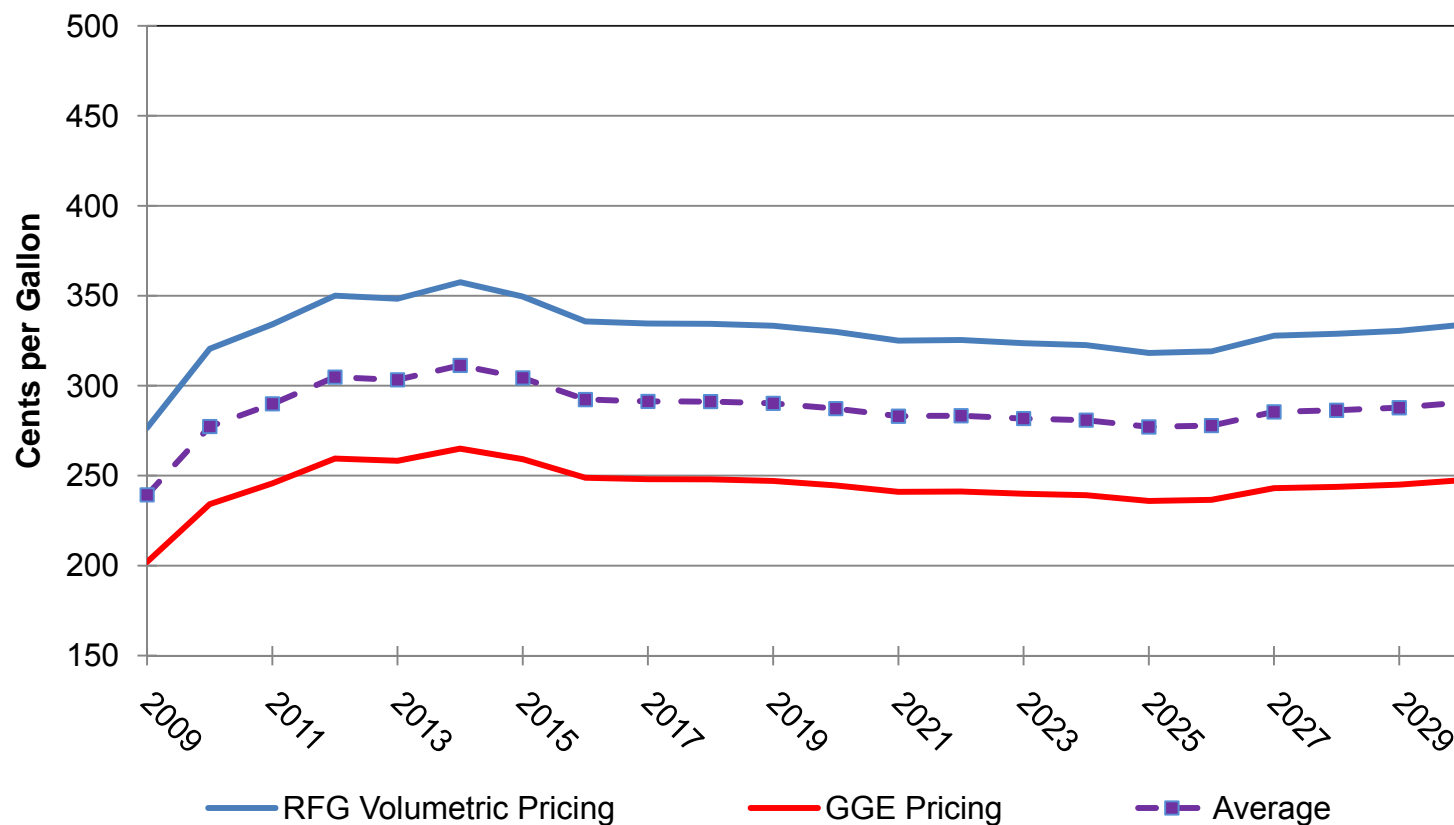
## Gasoline Gallon Equivalents (GGEs)

- Placing fuels in terms of the energy content of gasoline (for example 112,000 Btu LHV).
- Volumetric Pricing in terms of GGEs
  - $(\$2.00 \text{ per gallon of E85} / 81700 \text{ Btu per gallon of E85}) \times (112000 \text{ Btu per gallon of gasoline}) = \$2.74 \text{ per GGE based on volumetric equivalent pricing}$

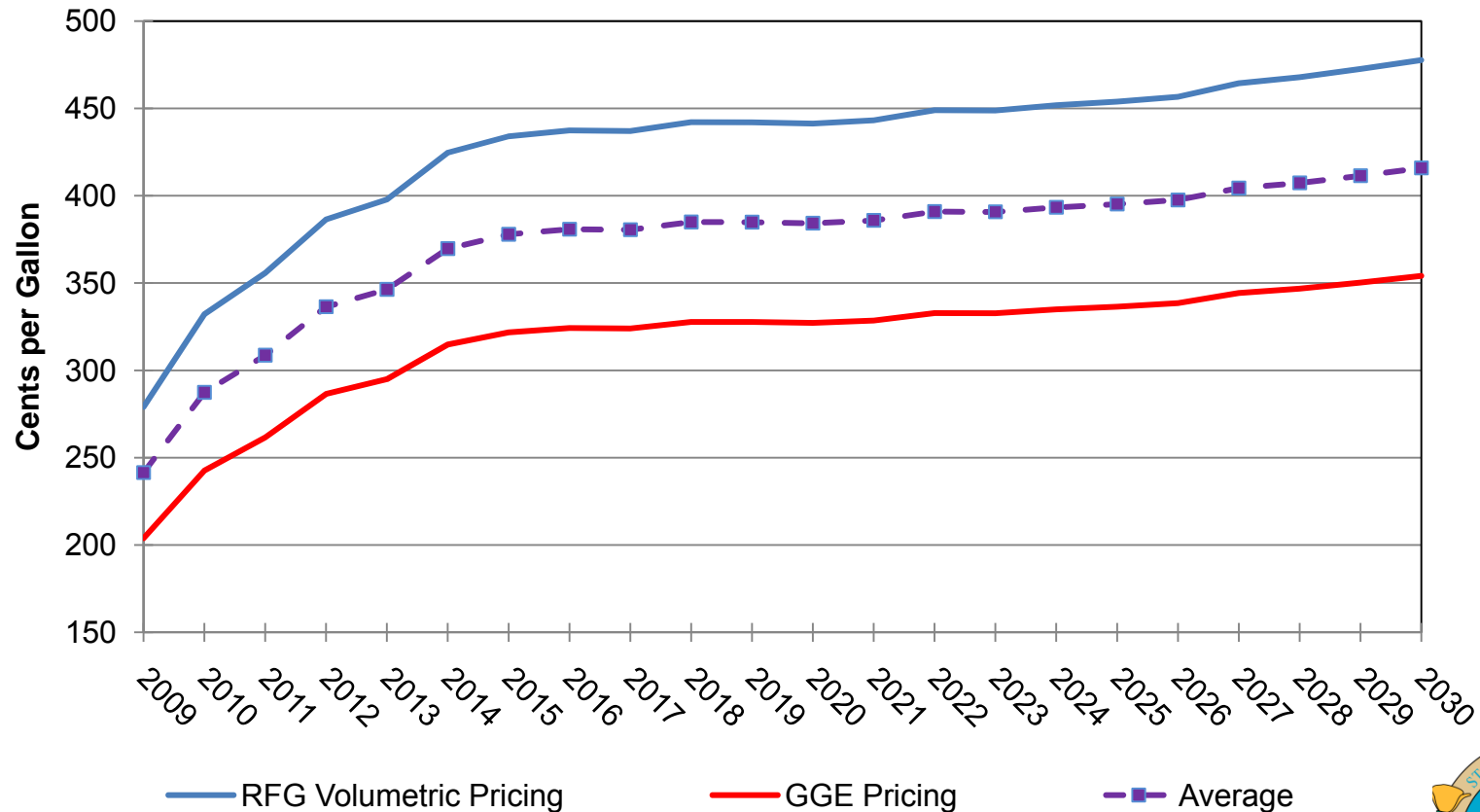




# California E-85 Price Forecast Corresponding to the RFG Low Case (2008 Cents)



# California E-85 Price Forecast Corresponding to the RFG High Case (2008 Cents)



# Biomass-Based Diesel

Biomass-based diesel is an umbrella term which includes:

- **Biodiesel**
- Renewable Diesel
- Biomass-to-Diesel
- Thermal Depolymerization
- Algae Diesel
- Others



# Biomass-Based Diesel Price Forecasting Method

- Use Energy Commission forecasted values for Diesel High and Low prices
- Compute historic monthly margins between West Coast rack prices and California Diesel rack prices
- Hold real federal fuel excise tax credit for biomass-based diesels constant
- Hold real state and federal taxes and fees constant

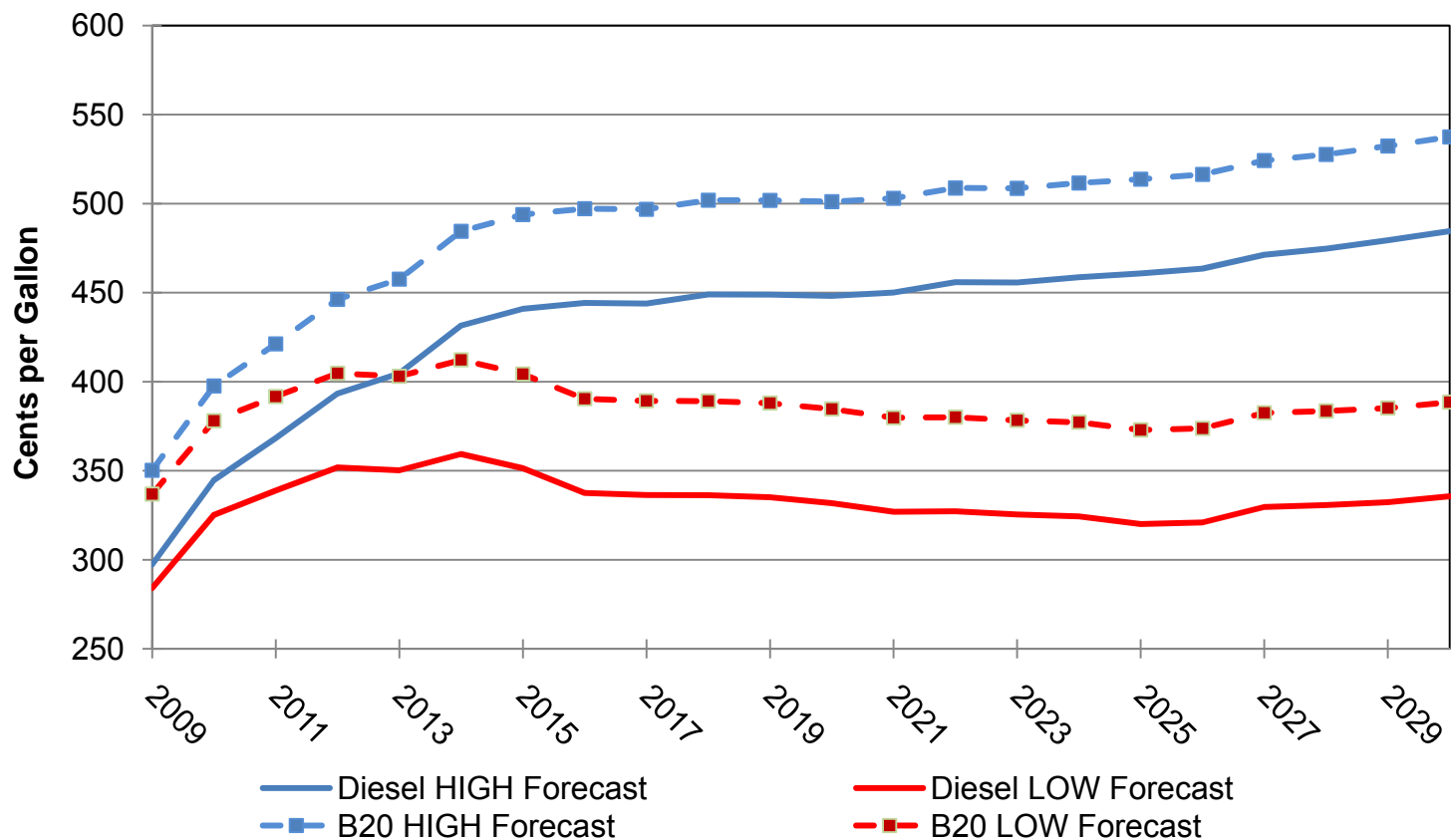


# Assumptions

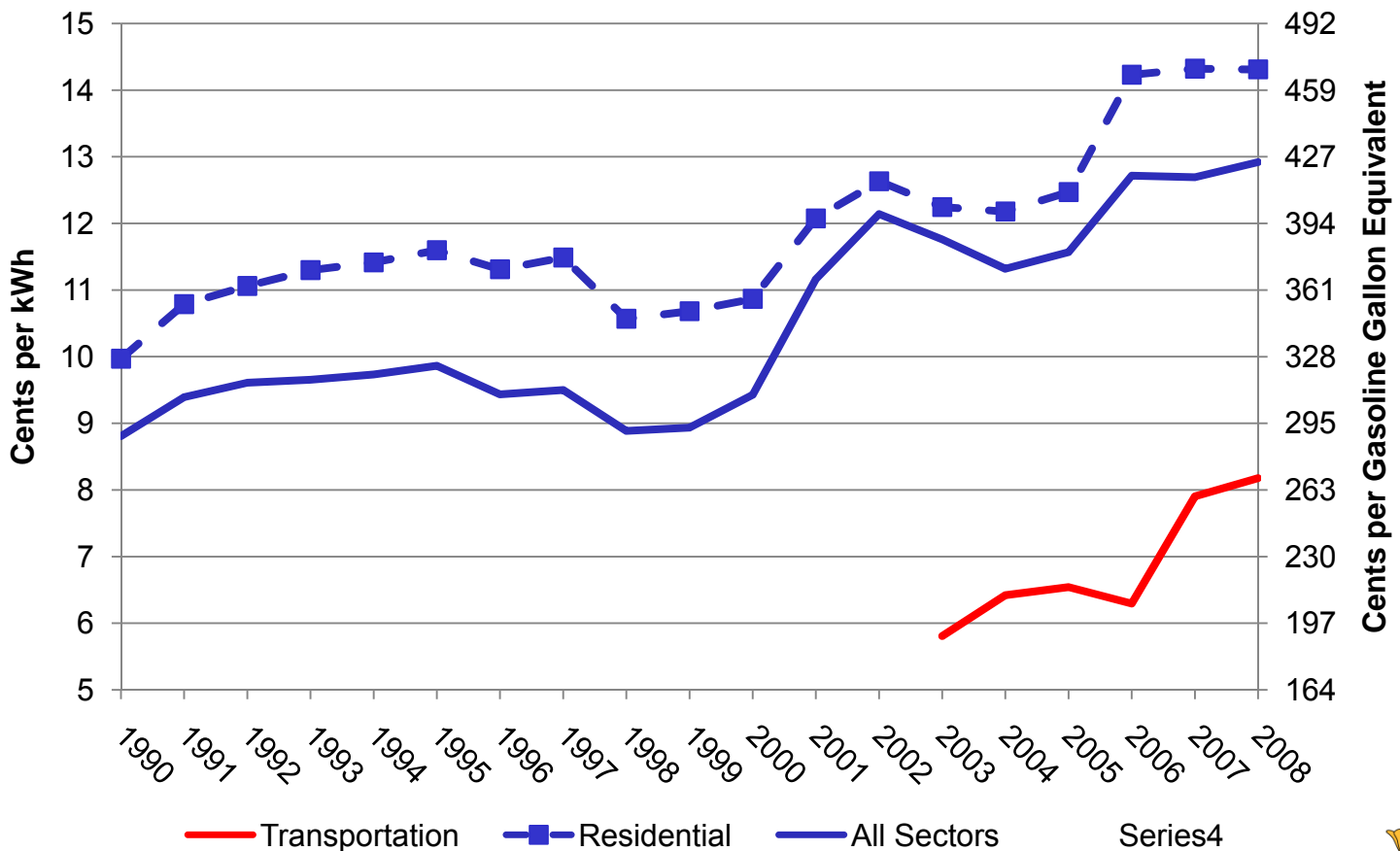
- The West Coast biodiesel rack price and California retail price relationships will remain constant over the forecast period and represents the retail fuel price of biodiesel in California
- Federal fuel excise tax credits will remain constant at \$1.00.
- State and local taxes will remain constant in real terms at their current rates
- Feedstock market prices will not affect the final retail price of biomass-based diesels
- The potential variation in fuel margins and feedstock prices is bounded by the high and low diesel price forecasts presented in this paper.
- Currently the federal excise tax credits will expire on December 31, 2009



# California Diesel and Biomass-Based Diesel Retail Price Forecast (2008 Cents)



# Historic California Electricity Prices



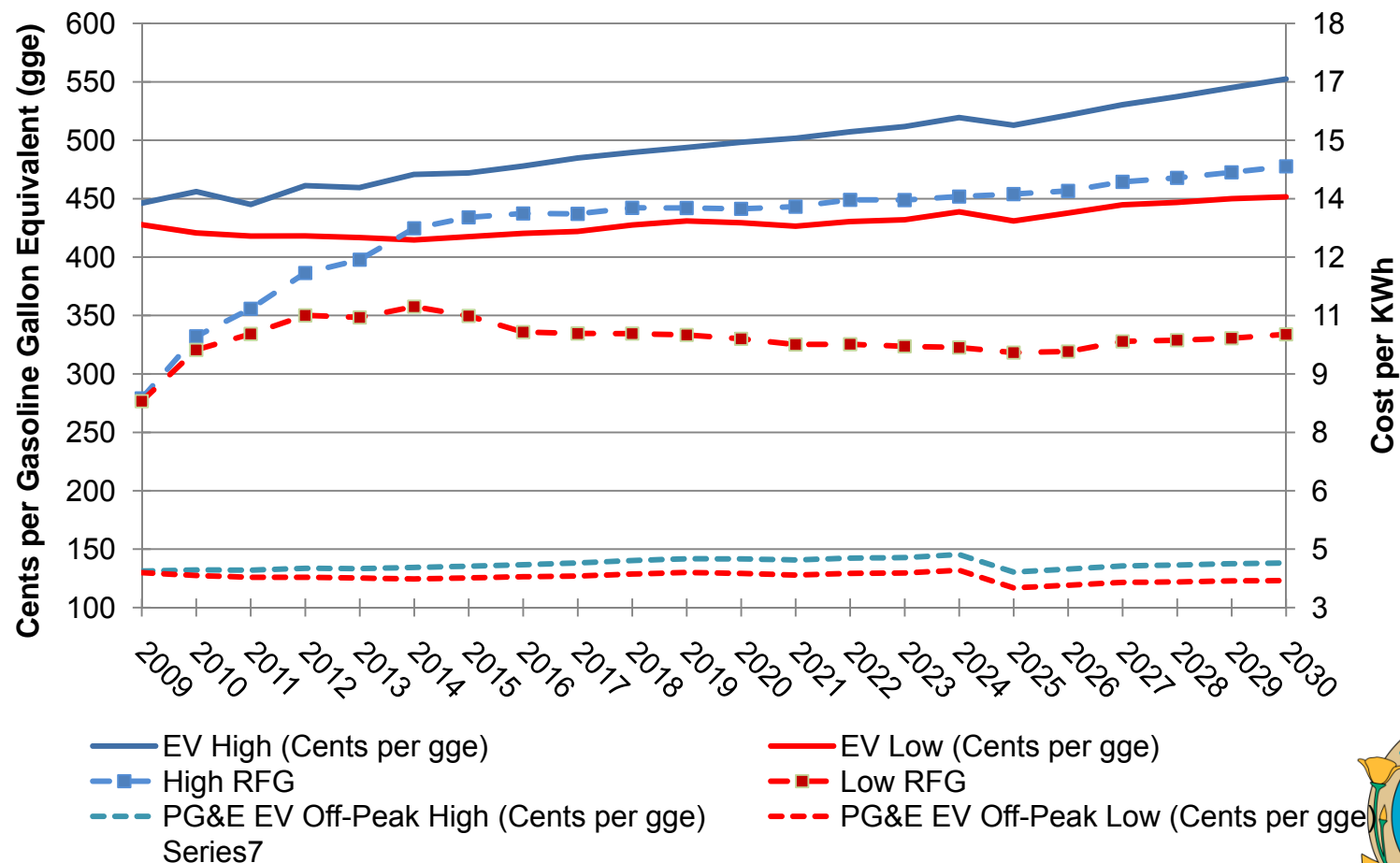
# Transportation Electricity Fuel Price Forecasting Method

- Rate structures for alternative fuel vehicles were used when available
- Marginal analysis was performed to develop the forecast and includes the addition of transportation electricity consumption
- Utilizes weighted average pricing of evaluated California MOUs and IOUs base on 2006 statewide consumption levels
- Generation and non-generation costs were increased over forecast period using the same method used in electricity evaluation for the 2007 IEPR

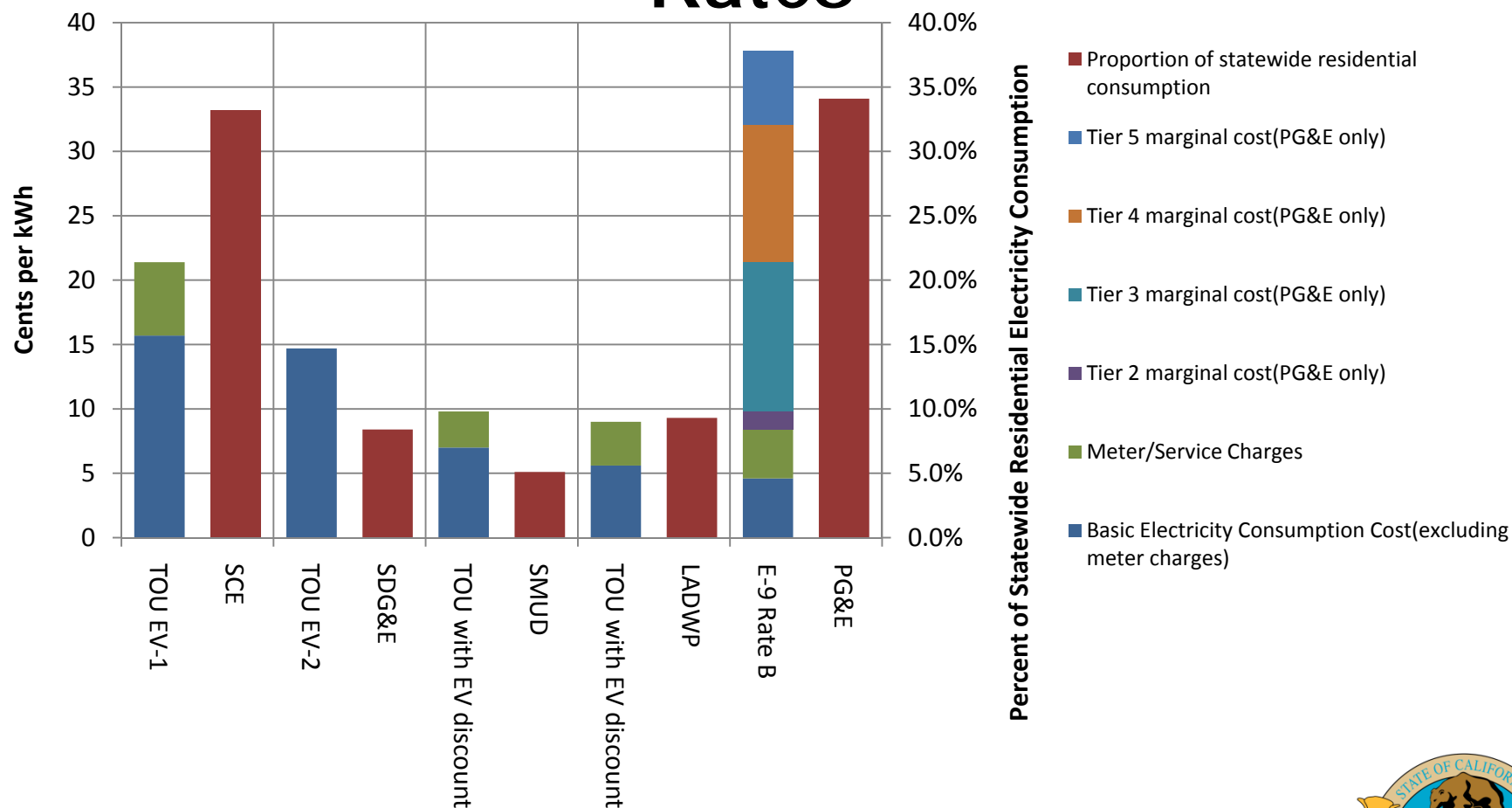




# California Transportation Electricity and RFG Price Forecasts (2008 Cents)



# California Electric Vehicle Off-Peak Tariff Rates



Note: No metering charges were applied to SDG&E TOU EV-2 because that rate structure shares metering with household electricity consumption. All other metering charges were obtained by dividing the monthly metering rate by a 175 kWh/month consumption assumption.



# Additional Assumptions

- Charging profile is assumed to be 88 percent off-peak, 8 percent partial peak, and 4 percent in peak hours
- 30 percent of PG&E customers were assumed to use Rate A, the remainder used Rate B
- No metering installation costs are assumed in the evaluation, high installation costs might inhibit adoption of dual metering
- Average monthly increase in electricity usage is assumed to be 175 kWh over normal usage
- Rate structures for alternative fuel vehicles were used when available

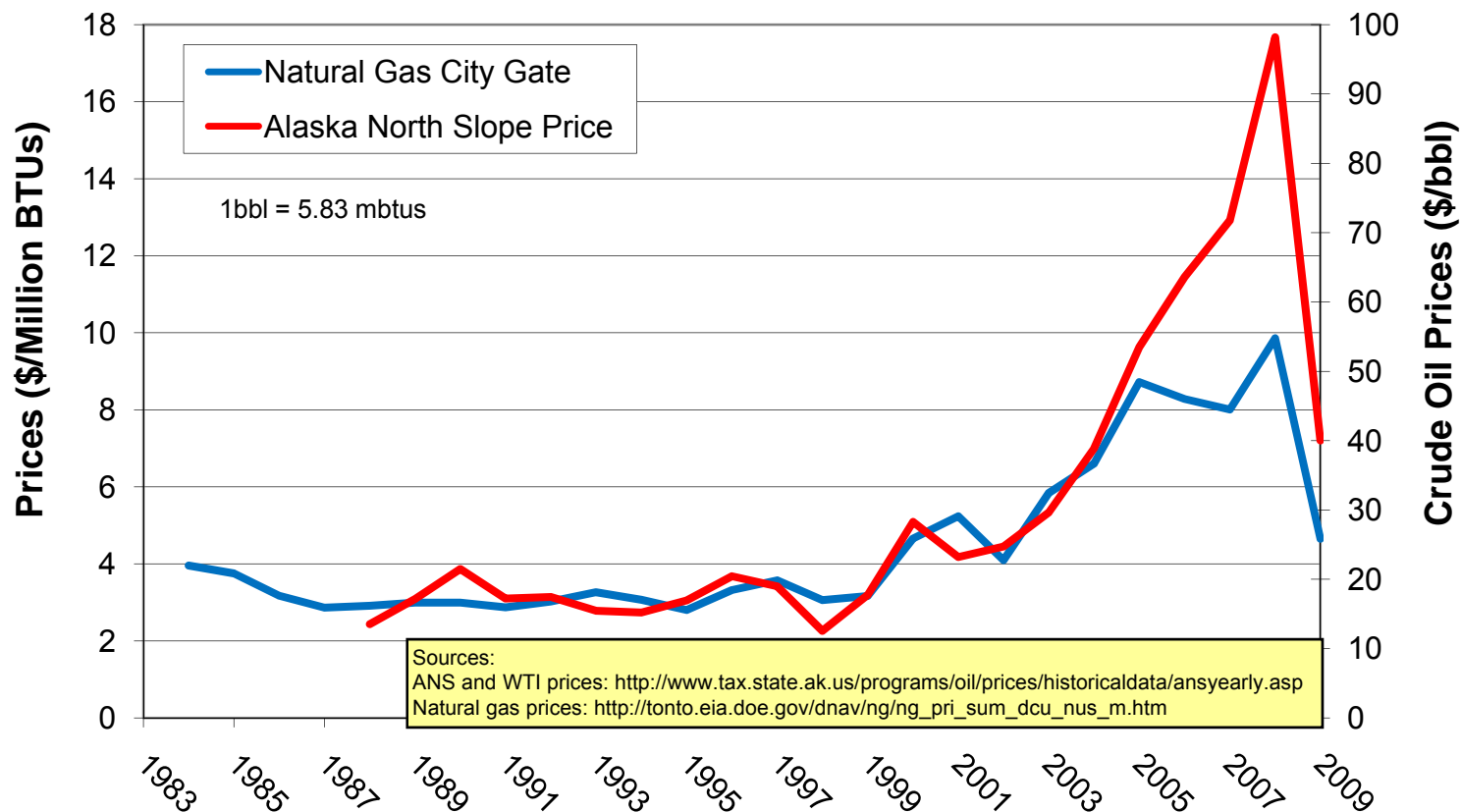


# Price Forecast for Transportation Natural Gas

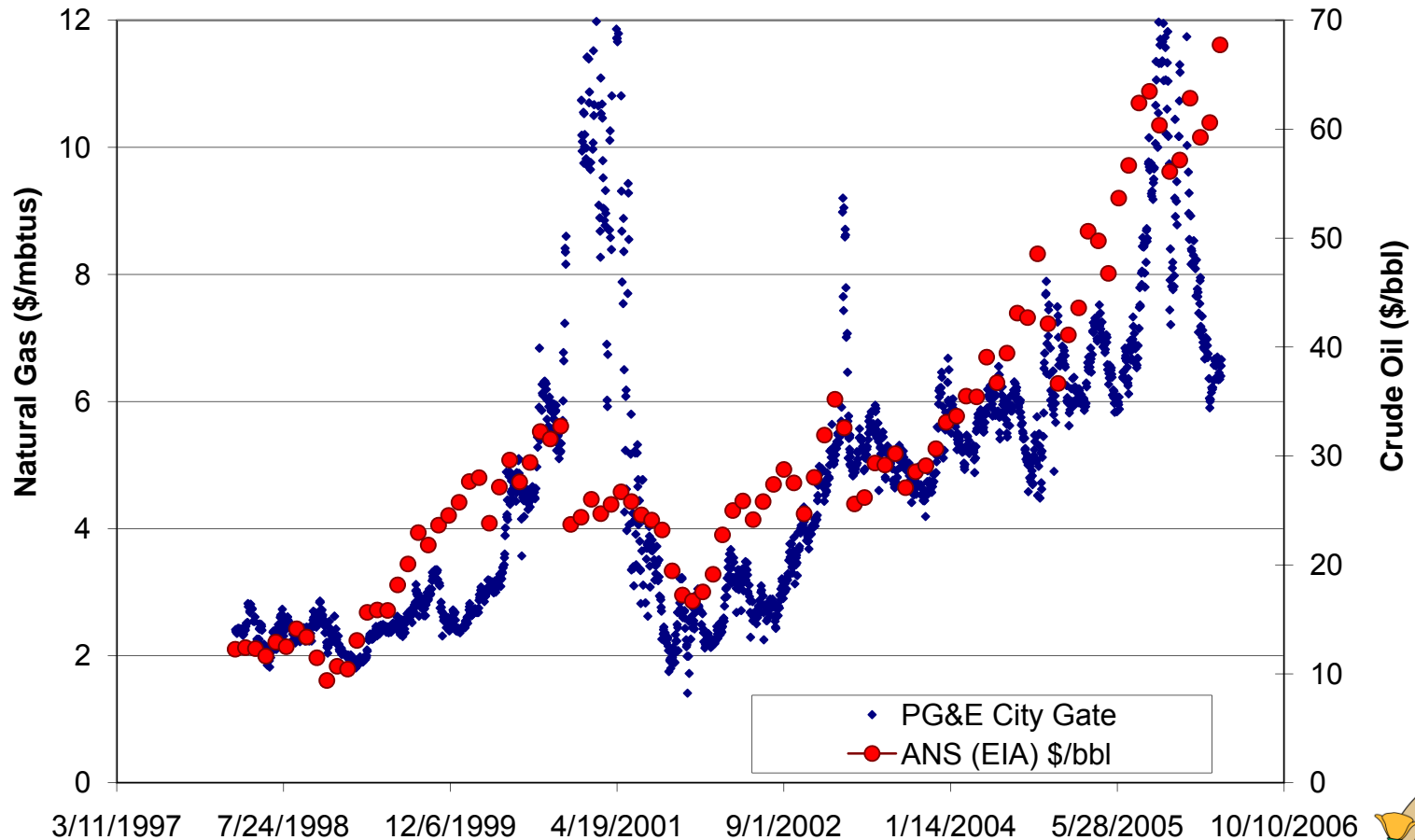
- The proposition is when crude oil prices are ‘High or Low’ as defined by the EIA benchmark levels, then what is the natural gas market price during those times.
- Staff evaluated crude to natural gas markets in two ways:
  - ❑ Top-Down (Retail Market)
  - ❑ Bottom-up (Commodity Cost Plus) Fuel modifications and Retail adders.



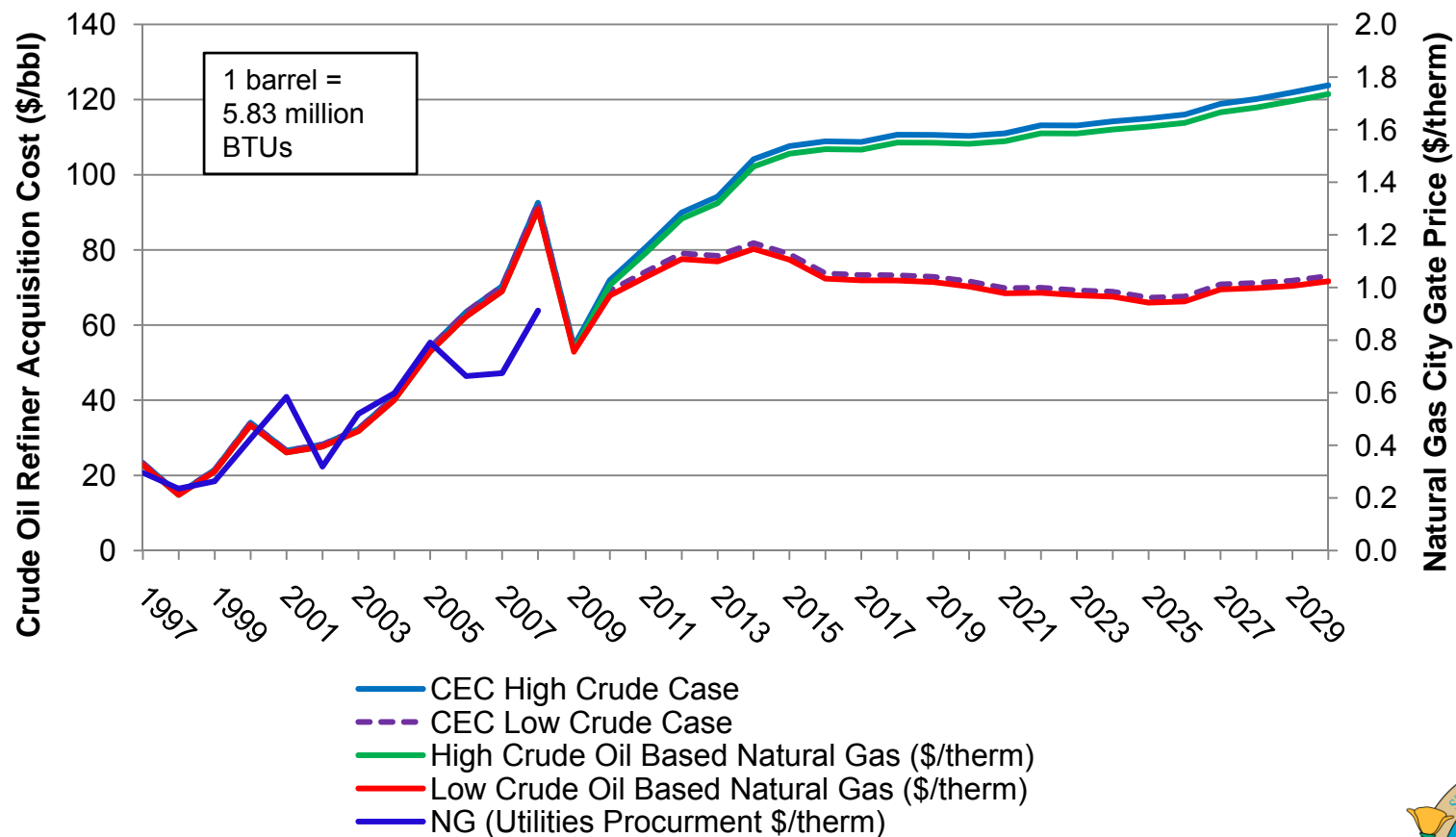
# Relationship Between U.S. Crude and Natural Gas Market Prices (Nominal Dollars)



# Recent Relationship Between Crude and Natural Gas Market Prices (California)



# Commodity Based (Bottom-Up) Based Natural Gas Forecast (Nominal Dollars)



Source: U.S. Energy Information Administration



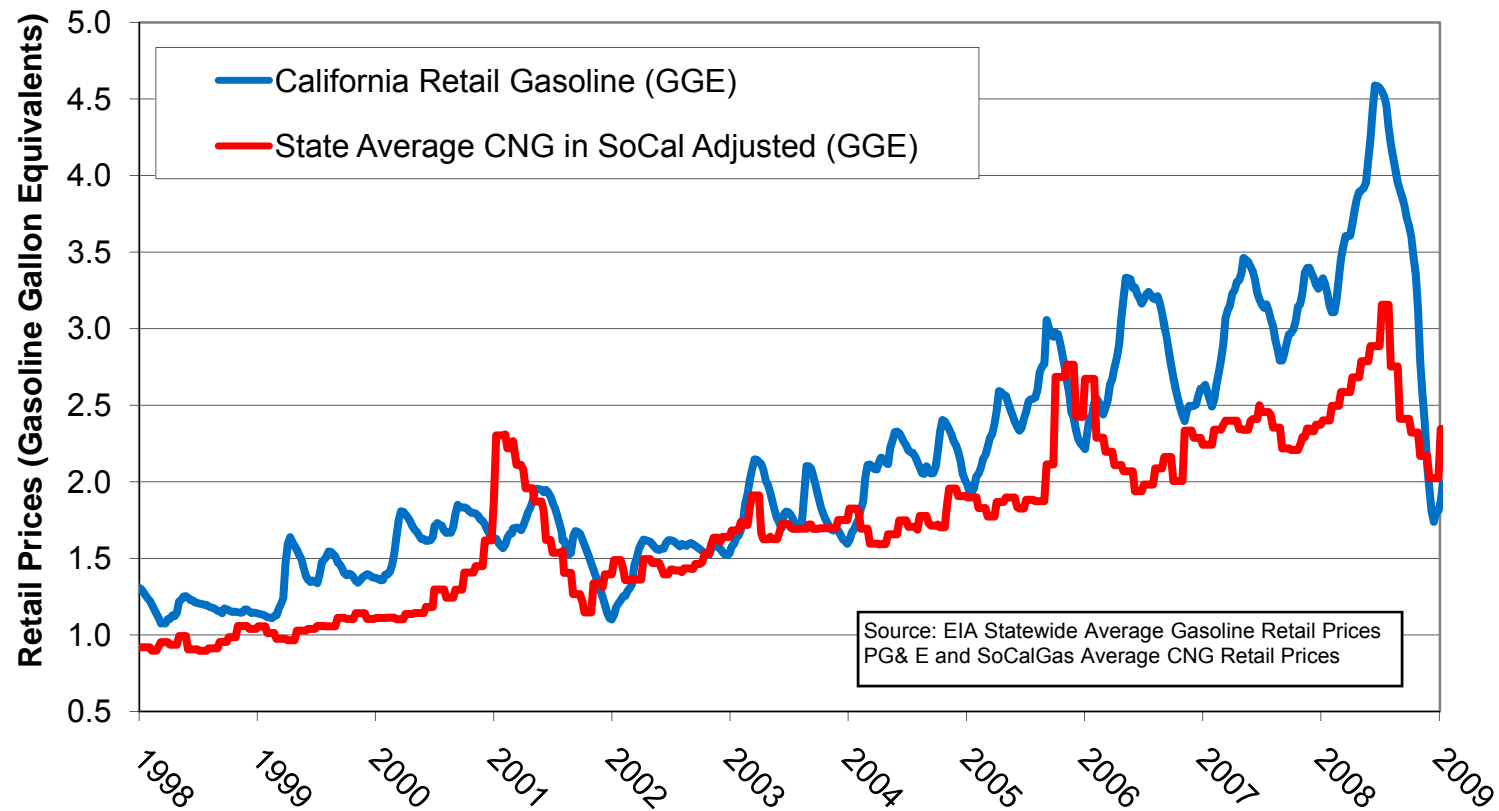
# Commodity Based (Bottom-Up) Price Calculations

	Street Units	(\$/mbtus)	%/total
Crude Oil Based Natural Gas (City Gate \$/therm)	1.00	0.100	34%
Intrastate Trans. (\$/therm)	0.0880	0.009	3%
Compression Expense (\$/therm)	0.7462	0.075	25%
<b>Sub-Total Gas (\$/therm)</b>	<b>1.83</b>	0.183	62%
SRF (\$/therm)	0.0680	0.007	2%
PPP (\$/therm)	0.02379	0.002	1%
UUT %	0.100	0.010	3%
SFT (\$/therm)	0.0677	0.007	2%
<b>Sub Total (\$/therm)</b>	<b>2.09</b>	0.209	71%
Sub Total (\$/GGE)	2.52	0.315	85%
Federal Excise Tax*	0.183	0.018	6%
Retail Margin	0.03	0.003	1%
Sales Tax (8%)	0.22	0.022	7%
<b>Retail price (\$/gasoline gallon equivalence)</b>	<b>\$2.95</b>		
<b>Retail price (\$/diesel gallon equivalence)</b>	<b>\$3.36</b>		

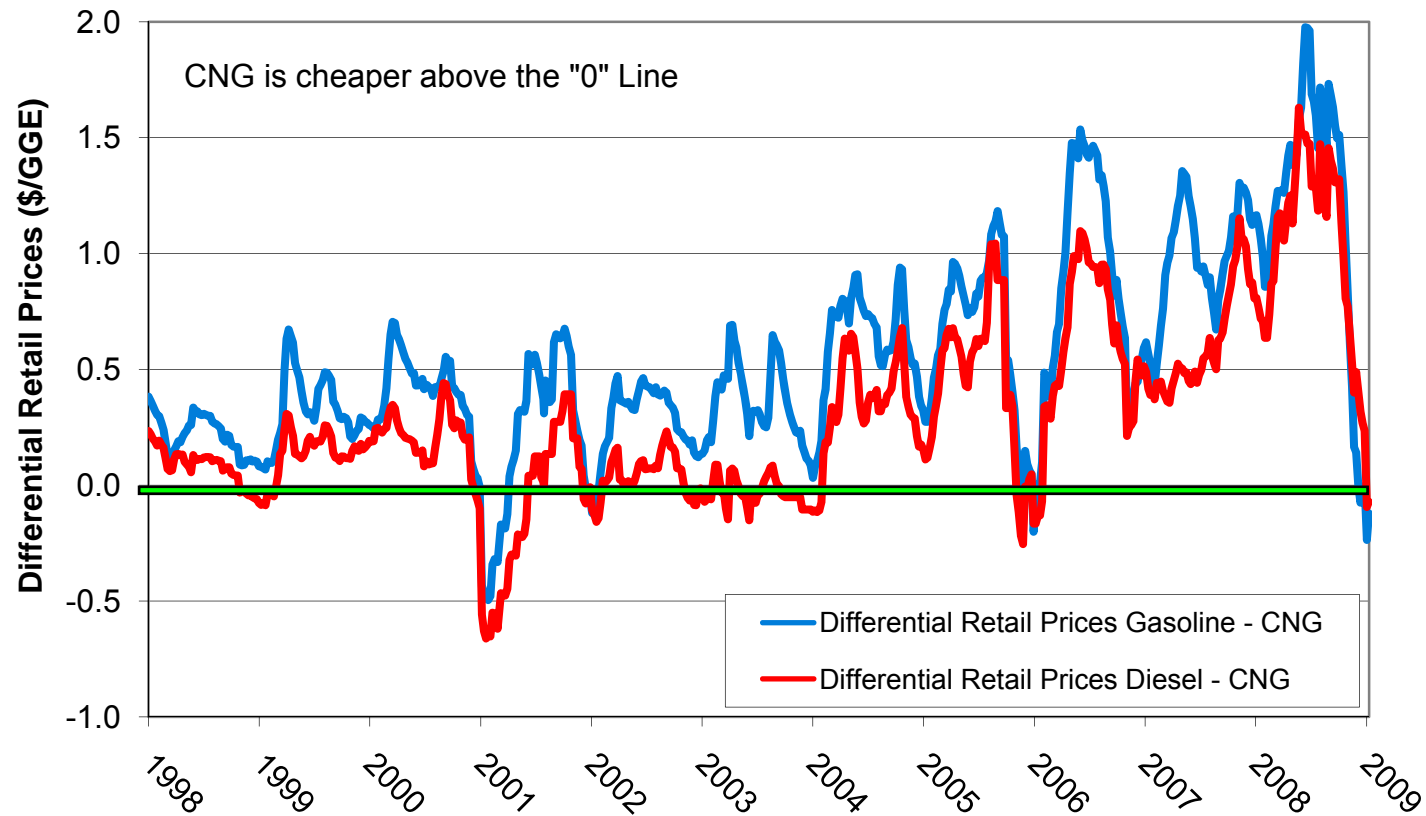




# Relationship Between Retail Gasoline and CNG Prices (California Market)



# Retail Market (Top-Down) Differential Price Relationship



# Retail Market Relationships (Top-Down)

## 10-year Summary of Retail CNG to Gasoline and Diesel Prices and Forecasting Adjustments

<b>Fuel</b>	<b>Retail Prices</b>	<b>Added Federal Excise Tax Change (0.1245 ¢/gge)</b>	<b>Added Retail Margin (6 ¢/gge)</b>	<b>Added State &amp; Local Sales Taxes (8%)</b>
Gasoline	\$0.55 (24%)	\$0.43 (16%)	\$0.37 (13%)	\$0.24 (6%)
Diesel	\$0.31 (13%)	\$0.18 (4%)	\$0.12 (0%)	-\$0.01 (-7%)

\*October 1, 2005 Federal Excise Taxes were raised for CNG, LNG and Propane (\$0.1245 for CNG)



# Results

## Summary of CNG Retail Price Relationship with Gasoline and Diesel

	<b>CNG Price Relative to Gasoline</b>	<b>CNG Price Relative to Diesel</b>
Commodity Based (Bottom-Up)	9 percent less	5 percent more
Retail Market Relationship (Top- Down)	6 percent less	7 percent more



# Retail Vs Fleet Fuel Price Assumptions

- Fleets' fuel prices are lower than retail prices for; diesel, gasoline, hydrogen by 50% of the margins.

	RFG Rack-to-Retail	Diesel Rack-to-Retail
CEC High	15.5	18.1
CEC Low	14.9	16.9

- CNG would avoid Rack-to-Retail deliver cost - fleets would expect to save 100% of the above Rack-to-Retail margins.



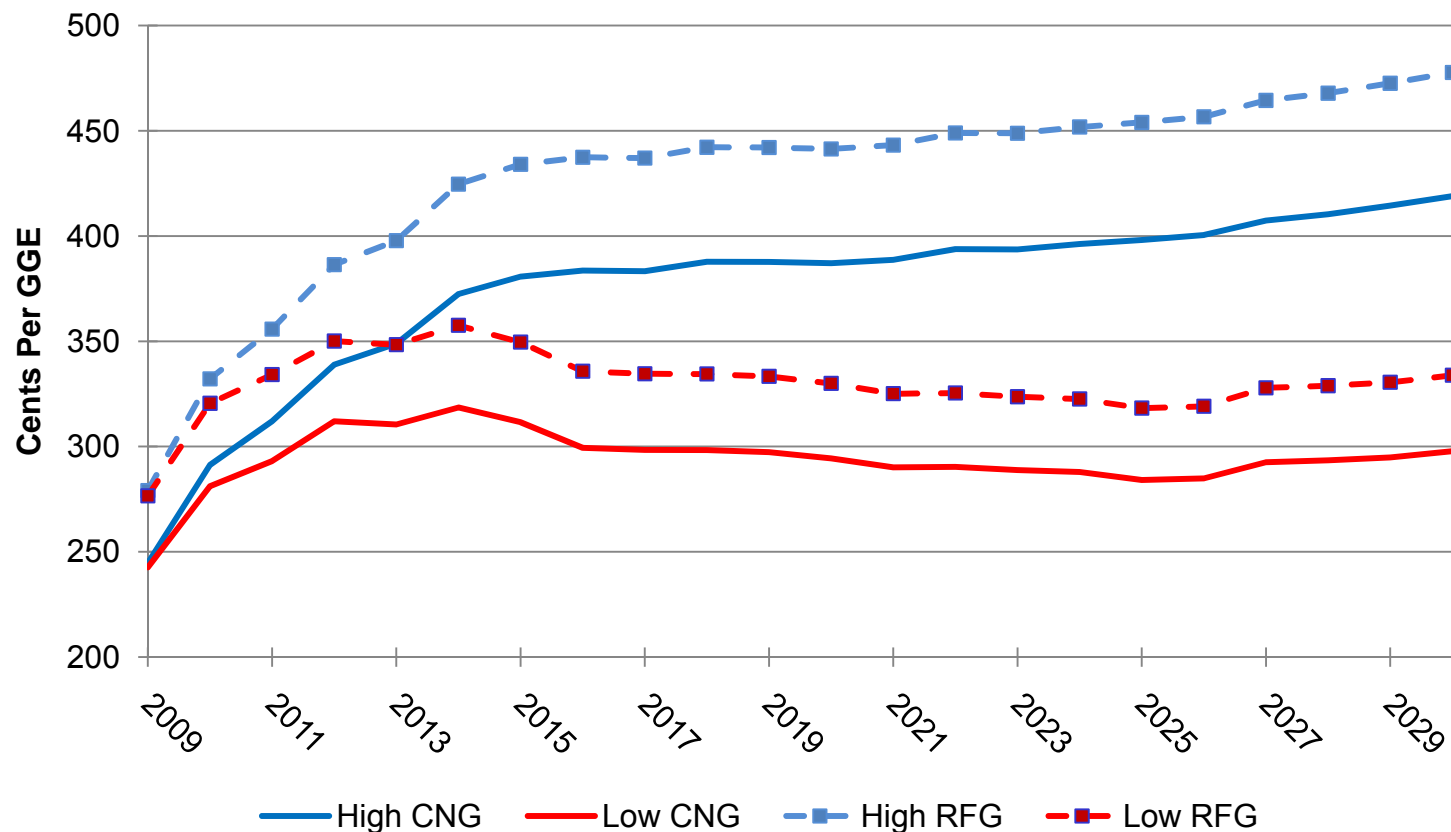
# LNG Retail Price Analysis

	(\$/LNG gal)	(\$/mill btus)	% of Cost
Natural Gas (\$/Therm) (Varied annually)	\$1.00		
NG feed cost (\$/LNG gallon)	1.21	\$15.8	67%
Cost to Liquefy (\$/LNG)	0.08	\$1.1	5%
Storage / Terminal Cost (\$/LNG)	0.01	\$0.1	1%
Transportation Cost (\$/LNG)	0.10	\$1.3	6%
Retail Markup/Customer/Storage Cost (\$/LNG)	0.10	\$1.3	6%
Capital Recover of Dispenser (\$/LNG)	0.02	\$0.2	1%
Excise taxes State (per LNG gallon)	0.02	\$0.3	1%
Excise taxes Federal (per LNG gallon)	0.13	\$1.6	7%
Sub total	1.68	\$21.9	
Sales Tax (8%)	0.13	\$1.8	7%
<b>Retail Price (\$/LNG gallon)</b>	<b>\$1.82</b>	<b>\$23.7</b>	<b>100%</b>

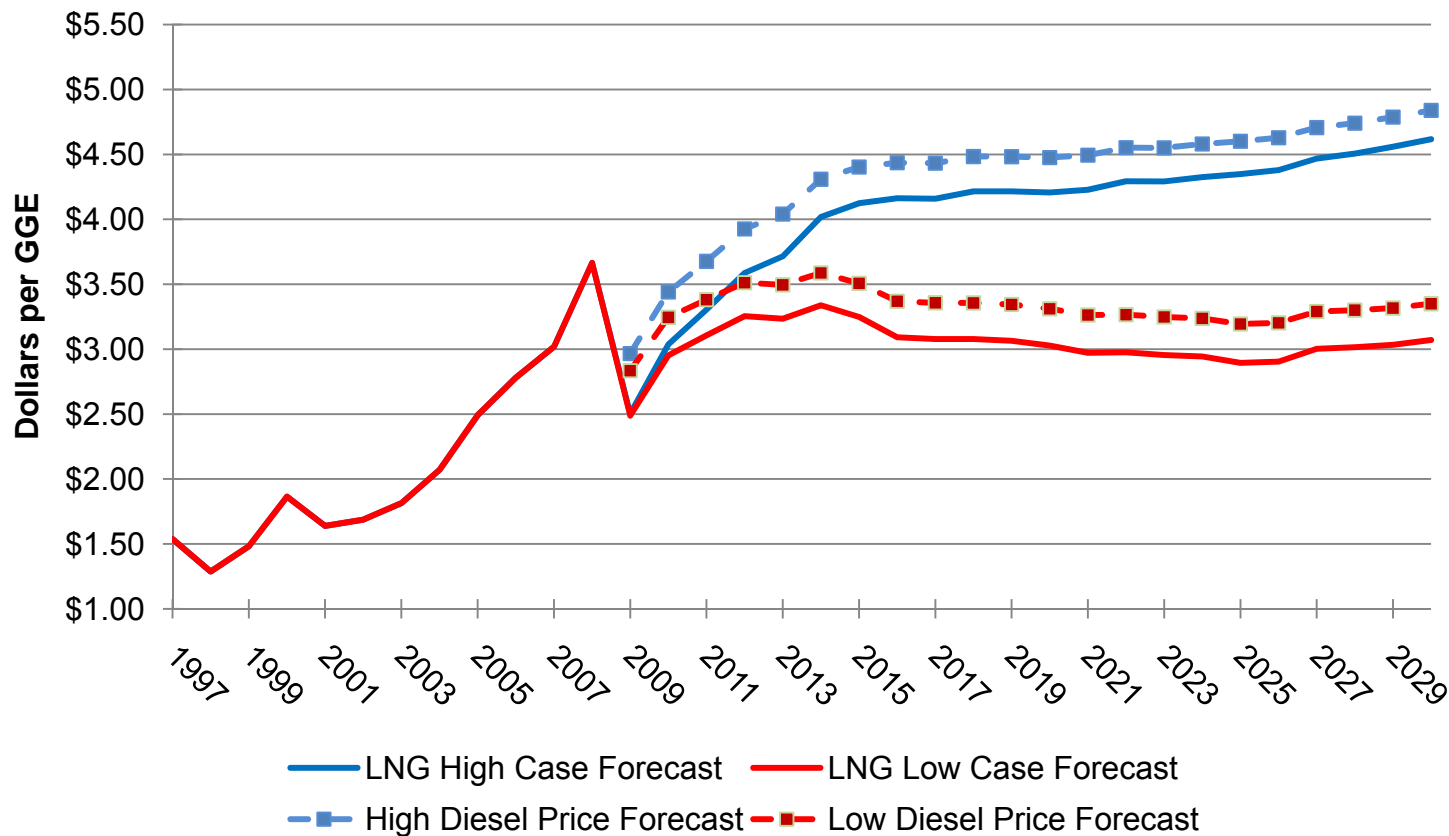
<b>Retail Price per Diesel Gallon Equivalent</b>	<b>\$3.02</b>
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# California Transportation CNG Price Forecast



# California Transportation LNG Price Forecast





# Hydrogen Price Forecasts

- Uses the same Natural Gas Forecast as CNG and LNG forecasts
- Production, Compression, Transportation, & Retail costs were accounted for (mostly constant in real terms)
- 8% sales tax is the only tax accounted for.

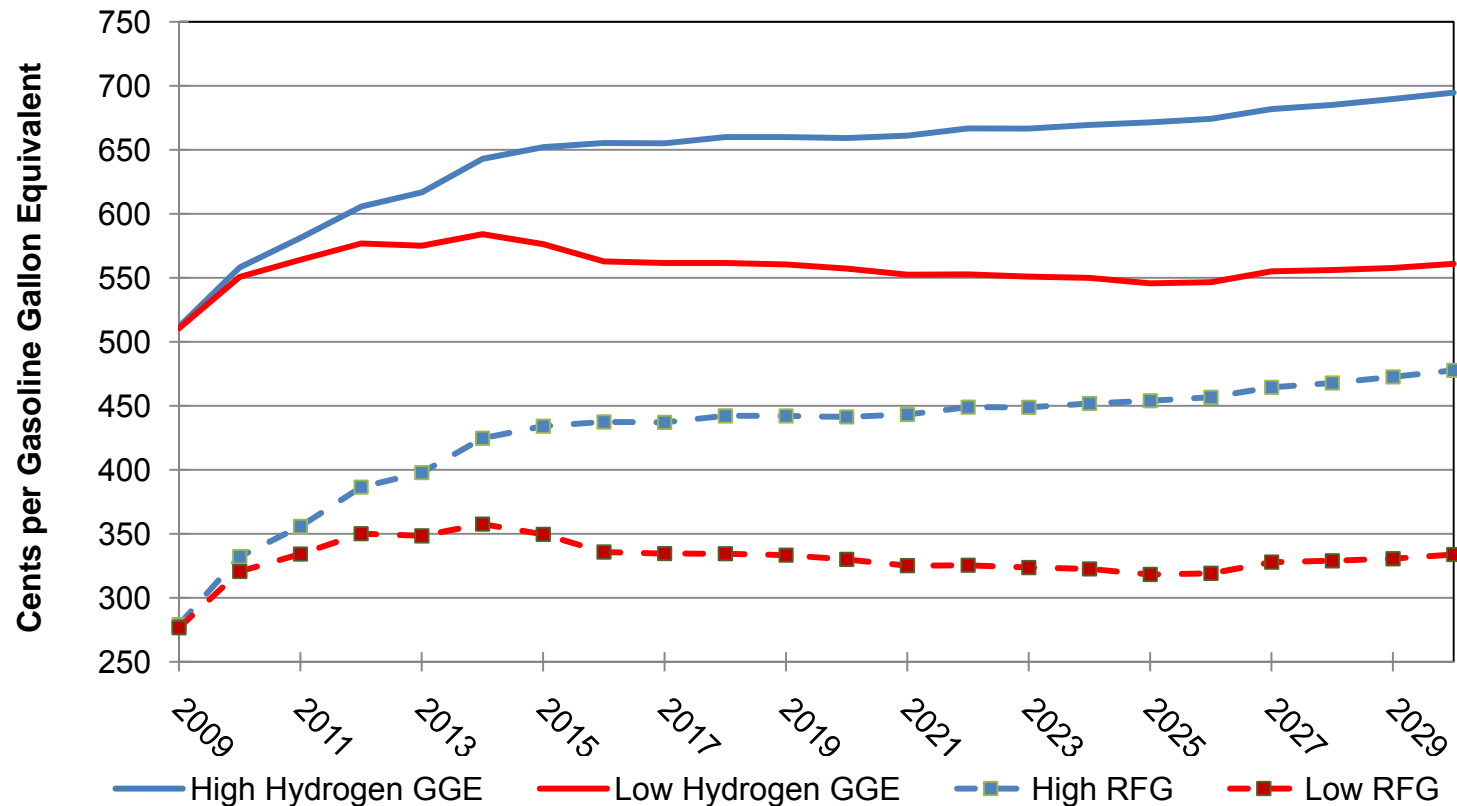


# Hydrogen Retail Price Components

(2008 \$)	(LHVs)	% of	
Hydrogen Production	\$/mbtus	Total Price	In GGEs
Natural Gas (\$ in LHVs)	9.55	21%	1.07
Variable Non-Fuel O&M (1%of Capital)	0.11	0%	0.01
Reformer @ x Efficiency 76%	2.29	5%	0.26
Fixed Operating Cost	0.56	1%	0.06
Capital Recovery	1.78	4%	0.20
Electricity (production & compress to 1Kpsi)	0.31	1%	0.03
Sub-total	14.61	32%	1.64
Compression Cost			
Capital Recovery	7.91	17%	0.89
Electricity	8.59	19%	0.96
Maintenance	5.05	11%	0.57
Sub-total	21.55	47%	2.41
Transport			
Over the road deliver cost	3.95	9%	0.44
Sub-total	3.95	9%	0.44
Retail			
Capital Recover Dispenser	1.22	3%	0.14
Retail Markup	1.00	2%	0.11
Retail full Markup	2.2	5%	0.25
H2 sub total pre tax	42.32	93%	4.74
Final Price with Sales Taxes	8%	45.71	100%
			5.12
\$ /Gasoline Gallon		\$5.12	



# California Transportation Hydrogen Price Forecast (2008 Cents)

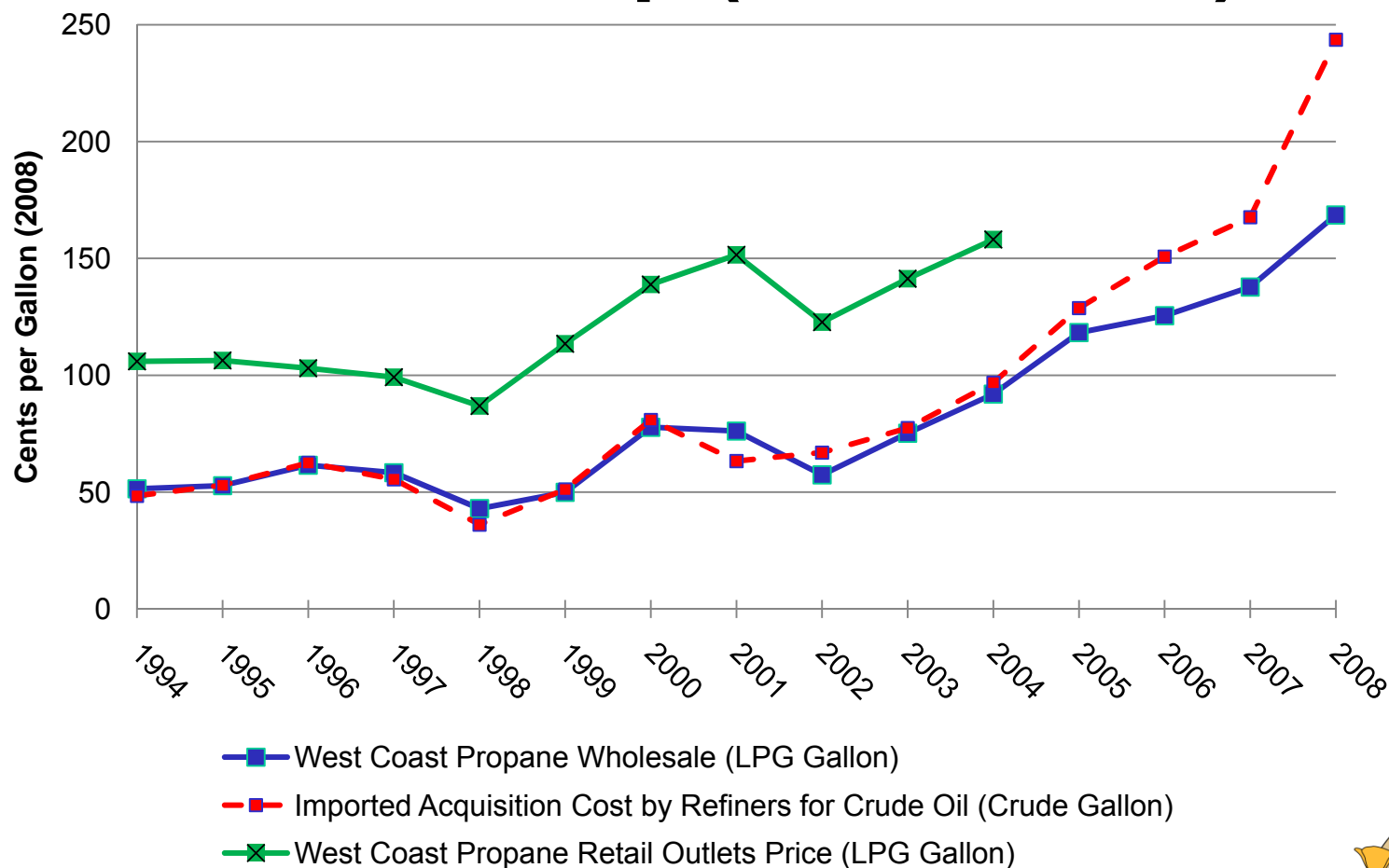


# Propane (LPG) Price Forecasts

- Wholesale propane was forecasted as a portion of RAC:
  - 91% in the High Case
  - 76% in the Low Case
- Rack-to-retail margins was forecasted as \$0.64 (High) & \$0.55 (Low)
- Excise taxes of \$0.243 (state & federal) held constant in real terms
- California sales tax of 8% held constant



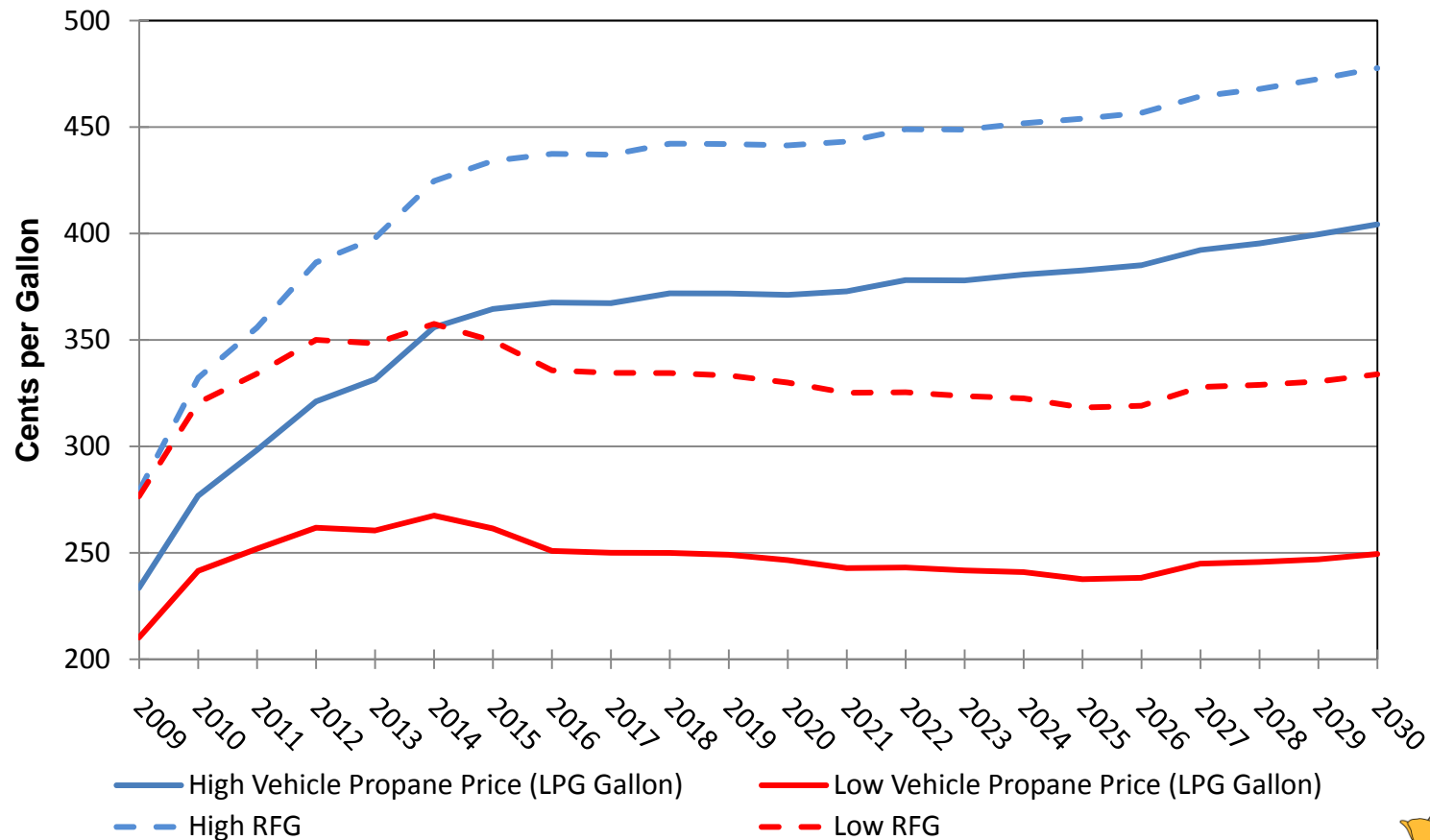
# Propane Wholesale Price Relationship (2008 Cents)



Source: U.S. Energy Information Administration



# California Transportation Propane (LPG) Price Forecast (2008 Cents)



# Next Steps

- Finalize inputs to demand forecasts
- Hold 2<sup>nd</sup> workshop on transportation energy infrastructure issues (April)
- Prepare demand forecasts and import requirements projections in draft staff report
- Hold 3<sup>rd</sup> workshop on staff's proposed transportation energy forecasts (June)
- Finalize staff report
- Integrate into IEPR transportation chapter



# Energy Commission Contacts

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